

AD-A156 841

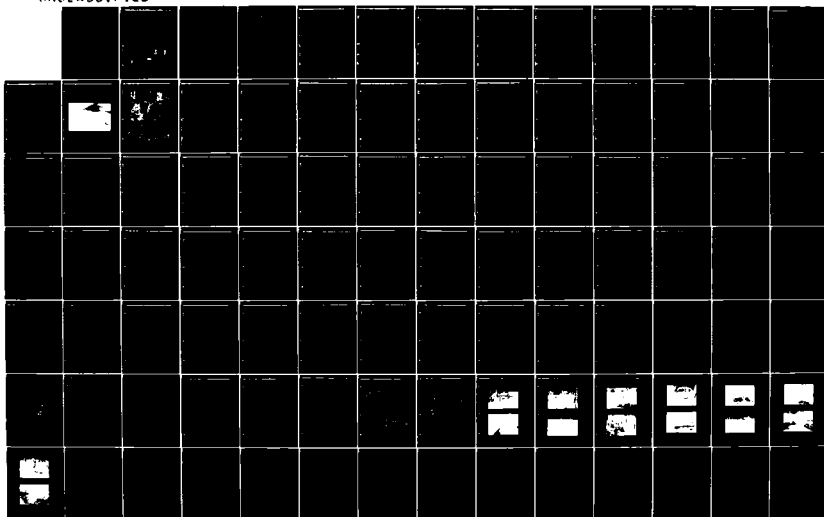
NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
PASCOAG RESERVOIR UPP. 101 CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV APR 79

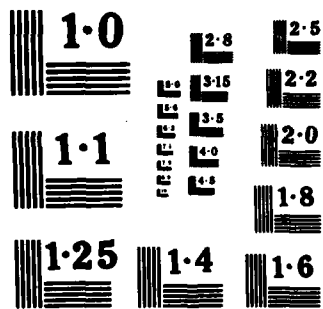
1/1

UNCLASSIFIED

F/G 13/13

NL





BLACKSTONE RIVER BASIN
BURRILLVILLE, RHODE ISLAND

PASCOAG RESERVOIR UPPER DAM
RI 00304

AD-A156 841

PHASE 1 INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DTIC
ELECTE
JUL 17 1985
S D G

DTIC FILE COPY



DISTRIBUTION STATEMENT A
Approved for public release
Distribution Unlimited

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

APRIL 1979

85 06 26 049

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER RI 00304	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Pascoag Reservoir Upper Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS		8. CONTRACT OR GRANT NUMBER(s)
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE April 1979
		13. NUMBER OF PAGES 71
		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) DAMS, INSPECTION, DAM SAFETY, Blackstone River Basin Burrillville Rhode Island		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The dam is an earth embankment structure. It is about 475 ft. long and 27 ft. high. The dam is considered to be in poor condition. To assure the long term performance of the dam, several items require attention. It is intermediate in size with a high hazard potential. Overtopping could result in failure of this dam. There are recommendations and remedial measures that should be implemented by the owner.		

DISCLAIMER NOTICE

**THIS DOCUMENT IS BEST QUALITY
PRACTICABLE. THE COPY FURNISHED
TO DTIC CONTAINED A SIGNIFICANT
NUMBER OF PAGES WHICH DO NOT
REPRODUCE LEGIBLY.**

BLACKSTONE RIVER BASIN
BURRILLVILLE, RHODE ISLAND

Accession For		
NTIS GRA&I <input checked="" type="checkbox"/>		
DTIC TAB <input checked="" type="checkbox"/>		
Unannounced <input type="checkbox"/>		
Justification <input type="checkbox"/>		
By _____		
Distribution/		
Availability Codes		
Dist	Avail and/or Special	
A/1	23 NY	

PASCOAG RESERVOIR UPPER DAM
RI 00304



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF
NEDED

Honorable J. Joseph Garrahy
Governor of the State of Rhode Island
and Providence Plantations
State House
Providence, Rhode Island 02903

Dear Governor Garrahy:

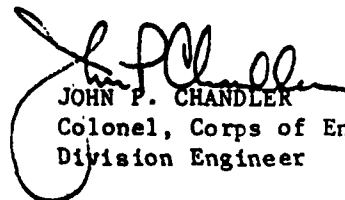
I am forwarding to you a copy of the Pascoag Reservoir Upper Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Management, the cooperating agency for the State of Rhode Island. In addition, a copy of the report has also been furnished the owner, Pascoag Reservoir Corporation, 18 East Avenue, Harrisville, Rhode Island 02830.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Management for your cooperation in carrying out this program.

Sincerely yours,


JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

NATIONAL DAM INSPECTION PROGRAM

PHASE I - INSPECTION REPORT

Identification No.: RI 00304
Name of Dam: Pascoag Reservoir Upper Dam
Town: Burrillville
County and State: Providence County, Rhode Island
Date of Inspection: December 1, 1978

BRIEF ASSESSMENT

The Pascoag Reservoir Upper Dam is an earth embankment structure constructed in 1860 to provide process water and electrical power for the Pascoag Woolen Company. The dam is approximately 475 feet long, 27 feet in height with a top width of 22 feet, and a crest elevation of 449.0. The outlet control structure is of stone masonry construction and is located near the left abutment of the dam. The outlet conduit is a 36-inch diameter cast iron pipe. The overflow spillway is a stone masonry broad crested weir, 21 feet long and is located at the left abutment of the dam. An earth dike approximately 310 feet long is west of the main dam embankment in an adjacent cove.

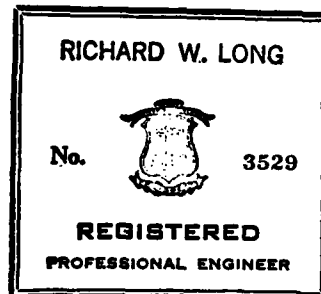
As a result of the visual inspection and the review of limited available data regarding this facility, the dam is considered to be in POOR condition. To assure the long term performance of this dam, several items of concern requiring attention are the apparent seepage through the embankment, the overgrowth of vegetation, the reduced cross section of the West Dike and areas of settlement and bulging of the embankments.

This dam is classified as INTERMEDIATE in size and a HIGH hazard structure in accordance with the recommended guidelines established by the Corps of Engineers. The test flood for this dam is the Probable Maximum Flood (PMF). A PMF test flood outflow of 8246 CFS (979 CSM) would overtop the dam by about 2.17 feet; therefore, the spillway is considered to be inadequate in size. Testing the dam using one half the PMF flow also results in overtopping the structure by 0.40 feet. The maximum spillway discharge of 1021 CFS represents only 12.4 percent of the test flood outflow. Overtopping could result in failure of this dam.

Additional recommendations and remedial measures that should be implemented by the Owner within a one-year period after receipt of this Phase I Inspection Report are described in Section 7.

C-E MAGUIRE, INC.

Richard W. Long
Richard W. Long, P.E.
Vice President



7

This Phase I Inspection Report on the Pascoag Reservoir Upper Dam has been reviewed by the undersigned Review Board Members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Joseph W. Finegan
JOSEPH W. FINEGAN, JR., MEMBER
Water Control Branch
Engineering Division

Joseph A. McElroy

JOSEPH A. MCELROY, MEMBER
Foundation & Materials Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, CHAIRMAN
Design Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar
JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or to property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any opportunity to detect unsafe conditions.

Phase I Inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonable possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

TABLE OF CONTENTS

	<u>Page</u>
LETTER OF TRANSMITTAL	
BRIEF ASSESSMENT	
REVIEW BOARD PAGE	
PREFACE	i
TABLE OF CONTENTS	ii
OVERVIEW PHOTO	vi
LOCATION MAP	vii

REPORT

SECTION 1 - PROJECT INFORMATION

1.1 General	1
a. Authority	
b. Purpose of Inspection	
1.2 Description of Project	1
a. Location	
b. Description of Dam and Appurtenances	
c. Size Classification	
d. Hazard Classification	
e. Ownership	
f. Operator	
g. Purpose of Dam	
h. Design and Construction History	
i. Normal Operational Procedure	
1.3 Pertinent Data	4
a. Drainage Area	
b. Discharge at Dam Site	
c. Elevation	
d. Reservoir Length	
e. Storage	

Page

- f. Reservoir Surface
- g. Dam
- h. Dike
- i. Spillway
- j. Regulating Outlets

SECTION 2 - ENGINEERING DATA

- | | |
|------------------------|----|
| 2.1 Design | 9 |
| 2.2 Construction Data | 9 |
| 2.3 Operation Data | 9 |
| 2.4 Evaluation of Data | 10 |

SECTION 3 - VISUAL INSPECTION

- | | |
|-----------------------|----|
| 3.1 Findings | 11 |
| a. General | |
| b. Dam | |
| c. West Dike | |
| d. Downstream Channel | |
| 3.2 Evaluation | 15 |

SECTION 4 - OPERATIONAL PROCEDURES

- | | |
|--|----|
| 4.1 Procedures | 16 |
| 4.2 Maintenance of Dam | 16 |
| 4.3 Maintenance of Operating Facilities | 16 |
| 4.4 Description of any Warning
System in Effect | 16 |
| 4.5 Evaluation | 17 |

	<u>Page</u>
SECTION 5 - HYDRAULIC/HYDROLOGIC	
5.1 Evaluation of Features	18
a. General	
b. Design Data	
c. Experience Data	
d. Visual Observation	
e. Test Flood Analysis	
f. Overtopping Potential	
g. Dam Failure Analysis	
SECTION 6 - STRUCTURAL STABILITY	
6.1 Evaluation of Structural Stability	23
a. Visual Observation	
b. Design and Construction Data	
c. Operating Records	
d. Post-Construction Changes	
e. Seismic Stability	
SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES	
7.1 Dam Assessment	25
a. Condition	
b. Adequacy of Information	
c. Urgency	
d. Need for Additional Investigation	
7.2 Recommendations	25
7.3 Remedial Measures	26
a. Operation and Maintenance Procedures	
7.4 Alternatives	27

SECTION 3

VISUAL INSPECTION

3.1 Findings

- a. General. Based on the visual inspection, the Pascoag Reservoir Upper Dam appears to be in poor condition. The embankments of the main dam as well as the dike section are heavily overgrown with brush and trees. Riprap has been dislodged on the upstream slope of the main dam. Vandals have destroyed the fencing that surrounds the gatehouse control structure and there is evidence of erosion and settlement of the dam. The dike located to the west of the main dam is similar in condition to the main embankment. Stone facing on the upstream and downstream faces is dislodged in areas and at one point is completely collapsed. Bulging of the embankment is also evident. A limited topographic survey along the crest of the dam and dike during the visual inspection indicates that the dike crest is one to two feet lower in elevation than the dam and would be overtopped under high reservoir stages before the main embankment. The general appearance of the dam and its appurtenances is poor.

- b. Dam.

1. Upstream Slope. In general, the upstream face of the dam is a grass covered earth slope with an inclination of approximately 1.25 to 1.5H:IV. At the time of the inspection, the elevation of the reservoir pool was approximately 11 feet below the crest of the dam.

The bottom 3 to 4 feet of the upstream slope was covered with riprap armor protection. In most cases, the stones were placed on the slope so that they formed a bench with a nearly vertical face at the bottom of the slope. The riprap contained stones of varying sizes up to a maximum of about 2 feet average diameter, and void spaces up to several inches in diameter were observed in between the stones.

The general configuration of the upstream slope is illustrated in Photo C-1,2 and a typical example of the riprap at the toe of the slope is shown in Photo C-2,6.

Several live trees and dead stumps were located on the earth slope and in the riprap as shown in Photo C-1,2,3,4, and several animal holes up to several inches in diameter were observed in the embankment.

2.4 Evaluation

- a. Availability. The information noted above for this facility is available in the files of the Department of Environmental Management, State of Rhode Island. No design information is available.
- b. Adequacy. The lack of indepth engineering data did not allow a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on the visual inspection, the dam's past performance, and sound engineering judgment.
- c. Validity. The validity of the limited information available must be verified.

SECTION 2

ENGINEERING DATA

2.1 Design

The following documents which contain the principal information regarding this dam and its appurtenances were reviewed in the preparation of this report.

Drawings:

1. Pascoag Reservoir - RI Department of Public Works, Division of Harbors & Rivers by the Works Project Administration, 12/6/40.
2. Plan of Dam at Pascoag Reservoir - Works Project Administration, February, 1939.
3. Waste Gate Works - Pascoag Water Supply Reservoir, Uxbridge Worsted Company by E. J. Cross, Co., Worcester, Massachusetts, March, 6, 1939, Drawings No. 59-1,2

Reports:

1. Annual Reports of the Commission of Dams, State of Rhode Island

<u>Year</u>	<u>Reference Page</u>
1883	39
1885	28
1890	21
1910	10
1924	5
1928	35
1929	8
1930	10
1931	106
1933	18
1934	Introduction and 16

2.2 Construction

There are no available records of the construction or repairs for this dam.

2.3 Operation

No formal records of operation are maintained for this facility. The annual report of the Commission of Dams - 1933 - contains a listing of water surface levels for the reservoir from May 15, 1868 through February, 1925.

- | | | |
|----|-----------------|-------------|
| 2. | Length of weir | 21.0 feet |
| 3. | Crest Elevation | 441.0 |
| 4. | Gates | None |
| 5. | U/S Channel | Natural Bed |
| 6. | D/S Channel | Natural Bed |
| 7. | General | -- |

j. Regulating Outlets

Refer to Paragraph 1.2b
 "Description of Dam and
 Appurtenances"
 for description of
 outlet works.

- | | | |
|----|-------------------|---|
| 1. | Downstream invert | 422.61 |
| 2. | Size | 3.0' diameter pipe |
| 3. | Description | Cast iron pipe |
| 4. | Control Mechanism | Hand operated, gear
mechanism - single gate |
| 5. | Other | Housed in timber
and metal framed
structure |

- | | | |
|-----|--|----------------------|
| 2. | Length (including 21.0 feet of spillway) | 475 feet |
| 3. | Height | 27.0 feet |
| 4. | Top width | 22.0 feet |
| 5. | Side slopes | 1.5H to 1V D/S & U/S |
| 6. | Zoning | Unknown |
| 7. | Impervious core | Unknown |
| 8. | Cutoff | Unknown |
| 9. | Grout Curtain | Unknown |
| 10. | Other | --- |

h. Dike

- | | | |
|-----|-------------------------------------|---|
| 1. | Type | Earth embankment, type of soil unknown. |
| 2. | Length | Total length is 310 feet. |
| 3. | Height | Varies from 10.0 to 12.0 feet. |
| 4. | Top Width | 25.0 feet |
| 5. | Side Slopes
vertical stone faced | |
| 6. | Zoning | Unknown |
| 7. | Impervious core | Unknown |
| 8. | Cutoff | Unknown |
| 9. | Grout Curtain | Unknown |
| 10. | Other | -- |

i. Spillway

- | | | |
|----|------|---|
| 1. | Type | Cut stone Masonry -
Broad Crested - overflow |
|----|------|---|

6. Spillway Crest 441.0 ±
- d. Reservoir Length (feet-scaled)
1. Length of Maximum Pool 10,400
 2. Length of Flood Control Pool N/A
 3. Length of Recreation Pool 10,400
- e. Storage (Acre-Feet) Total
1. Water Supply Pool N/A
 2. Flood Control Pool N/A
 3. Recreation Pool 5,000
 4. Top of Dam 9,000
 5. Test Flood Level 10,085
 6. Net storage between spillway crest and top of dam is 4,000 Ac-Ft. and represents 8.91 inches of runoff from the drainage area of 8.42 square miles
 7. One foot of surcharge storage equals 1.11 inches of runoff from the drainage area of 8.42 square miles.
- f. Reservoir Surface (acres)
1. Top dam 500
 2. Maximum Pool 500
 3. Flood-control pool N/A
 4. Recreation Pool 500
 5. Spillway crest 500
- g. Dam
1. Type (based on visual inspection) Earthen embankment with grassed top

1. Outlet Works: To Lower Pascoag Reservoir
30-inch diameter cast iron or steel pipe; downstream invert Elev. 422.61.
2. Maximum known flood at site
Unknown
3. Gated Outlet Capacity at normal pool level (Spillway Crest) Elev. 441
148 cfs
4. Overflow spillway capacity at maximum pool level (Top of Dam) Elev. 449.0
1,020 cfs
- Gated Outlet Capacity at maximum pool level (Top of Dam) Elev. 449.0
180 cfs
5. Total discharge capacity of spillway and outlet works at maximum pool level (Top of Dam) Elev. 449
1,200 cfs
6. Overflow spillway capacity of dam and spillway at "Test Flood" level Elev. 451.17
8,246 cfs
- Gated Outlet capacity at "Test Flood" level Elev. 451.17
188 cfs
7. Total outflow discharge capacity of Dam, Spillway and Outlet works at "Test Flood" level Elev. 451.17
8,434 cfs

c. Elevation (feet above National Geodetic Vertical Datum - NGVD)

1. Top of Dam
449.0+
2. Top of Dike
447.0-448.2+
3. Test Flood Pool Level
451.17
4. Recreation Pool Level
437.0 (See Section 1.2i)
5. Flood Control Pool
N/A

instituted that benefited, primarily, the lake's recreational summer use. The maximum allowable water surface level was placed at 4'-0" below the spillway crest (Elev. 441.00). In 1939, the Uxbridge Worsted Company repaired the Waste Gate Works. This work was designed and accomplished by E. J. Cross Company, Engineers and Contractors, Worcester, Massachusetts, and involved the construction and/or repair of the masonry inlet and outlet structures and the outlet pipe control valve. No subsequent work or repair has occurred at the facility.

- i. Normal Operating Procedures. Pascoag Reservoir Upper Dam is operated to provide recreational use of its impoundment. The Pascoag Reservoir Corporation maintains the water surface level by a directive from the State of Rhode Island at or below a level of 4.0 feet below spillway crest elevation 441.00, at all times. Record correspondence indicates that this level was established in 1934 by the Chief of Harbors and Rivers - State of Rhode Island to provide some measure of flood control storage in the reservoir due to the dam's close proximity to the populated village of Pascoag and the history of problems with the embankment.

1.3 Pertinent Data

- a. Drainage Area. The Pascoag Reservoir Upper Dam drainage basin, located in Providence County in northern Rhode Island, is oblong in shape with a length of 5.1 miles, an average width of 1.65 miles and a total watershed area of 8.42 square miles (See Appendix D for Basin Map). Approximately 5 percent of the watershed (0.42 square miles) is swampy or occupied by other water storage ponds. The topography is generally moderate to steep with elevations ranging from a high of 804.0 NGVD to 441.0 at spillway crest. Basin slopes range from 0.04 to 0.025 feet/foot and are considered to be moderate to steep. The time of concentration of the total watershed is estimated to be 2 to 3 hours and is relatively large which should reduce the likelihood of runoff peaking at the dam site due to an intense short duration rainfall. The Burlingame Reservoir also located in the watershed tends to moderately dampen and attenuate the peak of the surface runoff at the Pascoag facility.
- b. Discharge at Damsite. There is no discharge data available for this dam. Listed below are estimated discharge data for the spillway and outlet works.

systems adjacent to streets), and roadways (Route 100 and 3+ village streets within Pascoag). Failure will also cause extensive flooding damage within the village of Pascoag.

- e. Ownership: Pascoag Reservoir Corporation
18 East Avenue
Harrisville, Rhode Island
- f. Operator: Mr. Harry Holt
Main Street
Harrisville, Rhode Island
Residence (401) 568-4494
Business (401) 231-4500
- g. Purpose of the Dam: The dam was originally constructed to provide a continuous supply of process water and hydro-power to the downstream mills. Since the closing of these mills and the elimination of their need for the water, the reservoir has developed into a recreational impoundment providing fishing, boating and swimming for the area residents.
- h. Design and Construction History. This dam was constructed in 1860 under the direction of Cushing & DeWitt, Civil Engineer (address unknown). No records are available of the design, however, annual reports of the Commission of Dams, State of Rhode Island indicate the embankment is compacted earth, founded on hard pan and constructed with a chestnut plank sheet piling diaphragm. Because of the dam's close proximity to the village of Pascoag, its owners, the Pascoag Woolen Company seldom allowed the reservoir level to rise above the spillway crest. In 1910, the State ordered that the cross section of the embankment be restored to its original condition because of severe erosion that had occurred. In 1924, the dam was again reported to be in poor condition, according to the Dam Commission's Report. The floods of November 1927 caused little damage to the structure due mainly to the reduced reservoir level at the time of the storms; however, the State again directed that the embankment cross-section be restored. In 1928, plans by the Pascoag Woolen Company to upgrade the facility, for more efficient use of the water power, were dropped when the mill was sold. In December, 1928, the Pascoag Reservoir Corporation was ordered to maintain the reservoir level at 5.5 feet below the spillway crest. The 1929 annual report also indicates that 12 to 15 years prior to 1929, the embankment settled near the gatehouse and spillway and that forty to fifty yards of gravel were used to "remedy the defect." As the development around the reservoir increased, regulation of the water level was altered and, in 1934, a regulation schedule was

southeast-northwest axis. The Pascoag Reservoir Lower Dam is located approximately fifteen hundred feet to the north of this structure and backwater from the lower structure extends southerly to the downstream slope of the upper dam.

- b. Description of Dam and its Appurtenances. The Pascoag Reservoir Upper Dam is an earth embankment structure approximately 475.0 feet long, 27.0 feet in height, with an average crest width of 22.0 feet, and a crest elevation of 449.0 feet National Geodetic Vertical Datum (NGVD). The upstream face of the embankment is sloped at 1.5H to 1V and is protected by stone armor up to a level slightly above the spillway crest. The downstream slope is approximately 1.5H to 1V and heavily overgrown with trees and brush.

The outlet control structure is located on the upstream face of the dam adjacent to the overflow spillway, near the left abutment of the embankment. The intake inlet is constructed of cut stone masonry. The control mechanism for the 36-inch diameter outlet pipe is a vertical slide sluice gate and is housed within a timber frame gatehouse atop the inlet structure (See Photo C-6). Water is withdrawn from the upper reservoir through the 36-inch diameter pipe and is discharged through the submerged outlet on the downstream slope of the dam to Pascoag Lower Reservoir.

The overflow spillway structure is located at the left abutment of the embankment and is constructed of cut stone masonry. The spillway overflow weir is a broad crested section, 22.0 feet long. Spillway discharges flow into the lower reservoir. A timber service bridge spans the spillway training walls and provides access to the embankment (See Photo C-8).

An earth dike approximately 310 feet long is located in an adjacent cove formed by the reservoir west of the main embankment, a distance of 1,000 feet. The upstream and downstream faces of the dike are vertical with stone facing. The average crest width is 25.0 feet.

- c. Size Classification. Pascoag Reservoir Upper Dam has an impoundment capacity at the top of the dam (Elev. 449.0) of 9,000 Ac-Ft and a height of 27.0 feet, therefore, it is considered an INTERMEDIATE size structure.
- d. Hazard Classification. This dam is classified as a HIGH hazard structure because it is located in an area where failure may cause serious damage to homes (30+), commercial properties (10+), public utilities (overhead power and communication

NATIONAL DAM INSPECTION PROGRAM

PHASE I - INSPECTION REPORT

NAME OF DAM: PASCOAG RESERVOIR UPPER DAM

SECTION 1

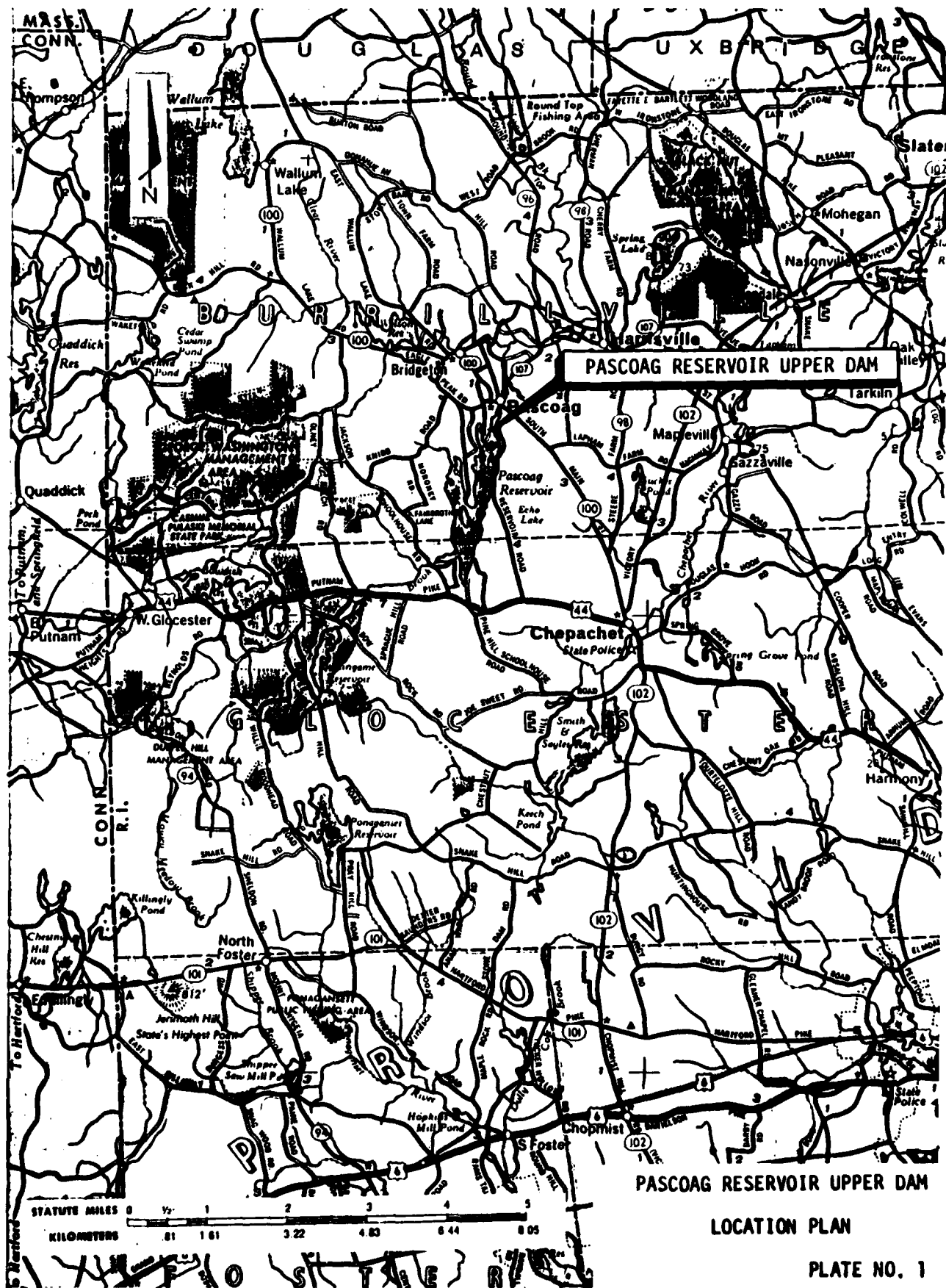
PROJECT INFORMATION

1.1 General

- a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army through the Corps of Engineers to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. C-E Maguire, Inc., has been retained by the New England Division to inspect and report on selected dams in the State of Rhode Island. Authorization and notice to proceed was issued to C-E Maguire, Inc., under a letter from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW33-79-C-0015 has been assigned by the Corps of Engineers for this work.
- b. Purpose.
 1. Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.
 2. Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.
 3. To update, verify and complete the National Inventory of Dams.

1.2 Description of the Project

- a. Location. Pascoag Reservoir Upper Dam is located in Providence County, Rhode Island, approximately 2,000 feet southeast of the village of Pascoag, Rhode Island. (See Plate No. 1). The dam impounds water from Brandy Brook which drains an 8.42 square mile watershed of moderately steep terrain. The reservoir is formed into a long, narrow body of water, approximately 2.0 miles long and one quarter of a mile wide, aligned in a



PASCOAG RESERVOIR UPPER DAM

LOCATION PLAN

PLATE NO. 1



OVERVIEW PHOTO - PASCOAG RESERVOIR UPPER DAM

APPENDICES

APPENDIX A - Inspection Check List

APPENDIX B - Engineering Data

APPENDIX C - Photographs

APPENDIX D - Hydrologic and Hydraulic Computations

APPENDIX E - Information as contained in the National Inventory of Dams

Many erosion features were located on the upstream slope of the dam. Erosion of the embankment was particularly severe adjacent to both the spillway structure and the gatehouse structure.

The spillway is located at Sta. 0+05 to 0+80. (See Appendix B-3 for Plan of Dam). The left and right spillway training walls are of wet stone masonry construction and the mortar pointing was cracked or missing in some locations. The right training wall is shown in Photo C-8. Immediately adjacent to both training walls the upstream slope is covered from toe to crest with riprap similar to that used along the toe of the upstream slope. Erosion was evident at the interfaces between the embankment and both training walls, as indicated by large windows in the riprap, depressions as deep as 15 to 18" in the slope and exposed tree roots.

The gatehouse is located at Sta. 1+30+. For a distance of approximately 20 feet to either side of the gatehouse, the upstream slope is covered from toe to crest with large stones up to an average diameter of approximately 4 feet, as illustrated in Photo C-6. There are large-diameter void spaces between the stones, and trees were observed growing in several of these spaces.

At approximately Sta. 4+20, near the right abutment, a bedrock outcrop was observed extending from the toe of the upstream slope into the reservoir.

2. Downstream Slope. In general, the downstream slope of the dam is an earth slope with an inclination of approximately 1V:1.5H. Immediately downstream of the dam is a small reservoir, Mill Pond, which is impounded behind a textile mill somewhat further downstream. At the time of the inspection, the water level in the Mill Pond was approximately 22 feet below the crest of the dam.

The downstream slope appears to be sparsely covered with grass but does have a thick growth of young trees and low shrubs with a fully developed root mat, as shown in Photo C-3,4. Evidence of erosion was observed over most of the downstream slope.

An erosion scarp varying from 1 to 2 feet in height was observed at the toe of the downstream slope over most of the length of the dam. At the time of the inspection, water was observed seeping out of the bottom of this scarp

which was approximately one foot higher than the water level in the Mill Pond.

Water was also observed seeping beneath the left training wall at the spillway and a small pool of water was observed in the downstream slope at approximately Sta. 0+00. This pool of water was approximately 4 feet long, 3 feet wide and 8 inches in depth, lined with stones; and the water level in the pool was approximately 3 feet below reservoir level at the time of the inspection. Water was observed running out of the pool into the spillway outlet channel and from there into the Mill Pond.

The outlet headwall is located at the toe of the downstream slope at approximately Sta. 1+25. The downstream slope above the headwall is covered with stones up to 3 feet average diameter and the slope in this area appears to be bulged outward. Several small scarps were observed near the top of the slope in this area.

Erosion gullies were observed on the downstream slope adjacent to both of the spillway training walls.

3. Crest: In general, the crest of the dam is grass covered with a sand and gravel pathway through the center, as shown in Photo C-5. There is some young tree growth on the crest, particularly on the downstream side.

An area of depression several inches deep was observed just to the left of the gatehouse.

c. West Dike

1. Upstream Slope. The upstream slope of the West Dike is nearly vertical dry stone masonry with soil fill behind it, as shown in Photo C-11,12. The maximum size and distribution of stones in the wall are not consistent, but rather vary from location to location. The top of the stone wall is approximately 1 to 2 feet below the crest of the dike.

Large void spaces were observed between stones in the wall and trees observed growing both out of the wall and at the base of the wall.

In several areas, part or all of the stone wall had collapsed exposing the soil behind. In these areas, erosion of the soil was observed.

At approximately Sta 0+60 and 2+00, bedrock outcrops were observed, extending from the location of the dike into the reservoir.

2. Downstream Slope. The downstream slope of the West Dike is a nearly vertical dry stone masonry wall similar to the upstream slope, as shown in Photo C-10.

Many small trees and shrubs were observed growing at the base of the downstream wall.

Between Sta. 0+90 and 1+05 most of the downstream wall has collapsed exposing the soil behind. In several other locations, the face of the downstream wall bulges outward.

At the time of the inspection, the water level in the reservoir was only one foot higher than the water level in the swampy area downstream at the West Dike, and no seepage was observed on the downstream slope.

3. Crest. In general, the crest of the West Dike is grass covered with a sand and gravel pathway along the upstream side, as shown in Photo C-13. Many trees and dead stumps were observed on the crest, particularly along the downstream edge.

The two areas of depression approximately 3 feet in diameter and 12 inches deep were observed adjacent to the downstream wall at approximately Sta. 1+60 and 1+80.

d. Downstream Channel

(1) Dam

As previously mentioned, the area immediately downstream from the dam is a small reservoir named Mill Pond. At the time of the inspection, most of Mill Pond was covered with a thin film of ice. However, a 30-inch diameter hole in the ice was observed approximately 35 feet below the toe at the downstream slope at approximately Sta. 2+50. This may indicate the presence of a seepage channel.

The spillway outlet channel flows from the downstream edges of the training walls to the Mill Pond through a sinuous channel in the downstream slope. There were many trees overhanging this channel and substantial large rocks and other debris on the bottom of the channel. Some erosion was observed on the banks of this channel. Near

the training walls, the bottom of the channel appeared to be bedrock. However, further downstream, it appeared to be soil covered.

(2) West Dike

Immediately downstream of the West Dike is a swampy area as shown in Photo C-10.

3.2 Evaluation

1. Dam

Based on the visual inspection, this dam appears to be in poor condition. The inspection disclosed the following items which affect the future performance of the dam.

- a. Erosion was observed on the upstream and downstream slopes, particularly adjacent to the spillway and outlet structures.
- b. There are many open windows in the riprap on the upstream face.
- c. There is an extensive root system associated with the trees and shrubs located on the embankment.
- d. There is an apparent depression of the crest adjacent to the gatehouse.
- e. Seepage and erosion are present at the downstream toe of the dam.

2. West Dike

The upstream and downstream slopes of the West Dike have eroded in the area of the collapsed wall. Depressions were observed adjacent to the downstream wall as well as bulges in the wall.

There are extensive tree roots in the dike and the open windows in the upstream and downstream stone walls.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedures

Downstream textile mills no longer use the waters impounded by the Pascoag Reservoir Upper Dam. Instead the reservoir is operated now for recreation only. The water surface level of the impoundment is maintained at or just below spillway crest from late spring through the summer months to provide optimum use for swimming, boating, and fishing. Generally, in October, the reservoir is drained to reduce the water surface level to approximately seven feet below the spillway crest and maintained at that level by operation of the sluice gate until spring.

4.2 Maintenance of the Dam

Maintenance of the dam is the responsibility of the Pascoag Reservoir Corporation. Inspections are conducted by the gate operator on a weekly or as needed basis. The only apparent maintenance for the dam that has occurred recently is the construction of a new service bridge across the spillway in 1976. No other maintenance of the dam was apparent or noted.

4.3 Maintenance of the Operating Equipment

The operating gate is exercised several times throughout the year, usually when the water surface of the impoundment needs to be adjusted. At the time of the visual inspection, the gate control mechanism was not operated but appeared to be in good condition. No record of inspection of the trash racks at the inlet for accumulation of sediment or debris was noted, although no difficulties have ever been reported.

4.4 Description of Any Warning System in Effect

Impending storms or intense rainfalls are monitored, as a rule, by the gate operator using weather forecasts issued on local radio or television networks. During critical periods of high reservoir levels and approaching intense storm activity, the operator would be on call or at the dam site as needed.

There is no pre-planned warning system for the failure of the Pascoag Reservoir Upper Dam. An emergency action plan must be developed so that operating personnel can notify authorities for mobilization of State or local emergency forces, organize remedial measures to minimize or prevent complete failure when possible, and have an

awareness of the locations of supplies, standby equipment and materials.

4.5 Evaluation

Operations procedures for this dam and the regulation of the water surface level do not agree with the timing and levels outlined in the record correspondence for this facility established by the State of Rhode Island. This apparent discrepancy needs to be clarified. It is evident that the facility has not been maintained. Further, an emergency action plan must be formulated and posted to insure proper and expedient action in time of emergency.

SECTION 5

HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

- a. General. Pascoag Reservoir Upper Dam, constructed in 1860, to provide process water and hydro-electric generating capacity for the textile mills downstream is located approximately 2,000 feet south of the village of Pascoag in northwest Rhode Island. The dam has a total length of 475.0 feet which includes a cut stone masonry overflow spillway that is 21.0 feet long. This impoundment has a storage capacity of 5000 Ac-Ft. at elevation 441.0, the spillway crest, that is equivalent to 11.1 inches of runoff from a watershed area of 8.42 square miles. Every foot of depth in the reservoir above spillway crest can accommodate 500 Ac-Ft. volume of water equivalent to 1.11 inches of runoff, or a total surcharge storage equal to 8.91 inches. This dam, therefore, is considered a storage facility with capacity to modify and reduce peak inflows.

The maximum spillway capacity of 1,021 cfs represents only 12.4 percent of the test flood outflow and is considered a low spillage storage structure. Overtopping for this earth embankment structure can be potentially hazardous.

- b. Design Data. The following hydraulic/hydrologic criteria were used in this Phase-I study.
 - i. The "Test Flood" and floods of lesser magnitude were developed for comparison purposes based on approved and standard procedures including Corps of Engineers' guidelines for Phase-I studies. See Conservation Service methods and other accepted procedures for computing runoff. The hydrologic characteristics such as upstream storage, basin slopes, watershed shape, etc., were qualitatively assumed in adopting various inflow discharge values.
 - ii. For outflow values, routing procedures, and dam failure profiles, a great emphasis was placed on the use of Corps of Engineers guidelines and Research Notes, published by the Hydrological Engineering Center at Davis, California, for guidance. Professional judgment was used in calculating final values outlined in this report, which are quite approximate and should not be considered a substitute for actual detail analysis.

No specific design data is available for this watershed or for the structures of the Pascoag Reservoir Upper Dam. In lieu of existing design information, U.S.G.S. Topographic Maps (Scale 1"= 2000') were utilized to develop hydrologic parameters such as drainage and reservoir surface areas, basin slopes, time of concentration and other runoff characteristics. Elevation - storage relationships for the reservoir were approximated. (See Appendix D.) Surcharge storage was computed assuming that the surface area remained constant above the spillway crest. Some of the pertinent hydraulic design data was obtained and/or confirmed by actual field measurements at the time of the visual field inspection.

Pascoag Reservoir Upper Dam was classified as being intermediate in size, having a storage capacity of 9,000 Ac-Ft. at the top of the dam. The height of the dam was 27 feet. To determine the hazard classification for this dam, the impact was assessed if failure were to occur when the pool level was at the top of the dam. As a result of the analysis, Pascoag Reservoir Upper Dam was classified as a high hazard structure.

- c. Experience Data. No historical discharge data is available for this dam. Intermittent records of water surface levels have been maintained as referenced in Section 2.3 of this report and more recently by the gate operator. No other data is available.
- d. Visual Observations.
 - 1. Miscellaneous debris was observed behind the trash bar protecting the upstream intake to the outlet works. This debris needs to be removed to prevent clogging of the outlet and loss of regulation of the water surface. An obstruction within the outlet conduit (3.0 feet diameter) beneath the embankment would be a difficult maintenance problem and place the dam in a hazardous condition.
 - 2. The overflow spillway constructed of cut stone masonry has loose joints, some dislodged stonework, and missing grout.
 - 3. The downstream spillway channel is overgrown with brush and large diameter trees which need to be removed in order for unobstructed flow to occur during high reservoir levels and intense storm activity.
- e. Test Flood Analysis. The recommended guidelines for the Safety Inspection of Dams by the Corps of Engineers were used to select the "Test Flood" discharge. Since this dam is classi-

fied as a high hazard structure and intermediate in size, the guidelines indicate that the full P.M.F. be used as the test flood. Out of the total 8.42 square mile watershed, 0.42 square miles (or 5%) is considered swampy or covered by storage reservoirs. The average basin slope is 0.04 feet/foot, which can be classified as moderately steep and the watershed generalized as flat to rolling. A "test flood" equal to the full P.M.F. was calculated to be 1250 CSM, equal to 10525 CFS for the drainage area. Outflow discharges were also developed using the Corps of Engineers criteria for approximate routing. The outflow discharge value for the test flood inflow was 8246 CFS. Additional design data developed for this investigation has been tabulated at the end of this section.

- f. Overtopping Potential. The spillway capacity is hydraulically inadequate to pass the "test flood" (PMF) and this discharge would overtop the dam by approximately 2.17 feet. The inflow and outflow discharge values for this test flood are 10525 CFS and 8246 CFS, respectively. The maximum outflow capacity of the spillway, in a still reservoir condition, without overtopping is 1021 CFS or 12.4 percent of the test flood discharge. The overtopping potential for discharges of lesser magnitudes and frequencies were computed approximately and are tabulated at the end of this section. See Appendix D for this spillway rating curve.

At the spillway crest elevation of 441.0, the capacity of the outlet structure is 148 CFS. At that level, 41.0 hours are required to lower the reservoir surface one foot.

One foot of depth of the reservoir at spillway crest can approximately accommodate 1.11 inches of effective rainfall. Consequently it is estimated that overtopping of the dam can be eliminated by the "test flood" flow if the water surface elevation in the reservoir is kept 9.1 feet below the spillway crest.

- g. Dam Failure Analysis. The calculated dam failure discharge of 17818 CFS (assuming the initial impoundment water level at the top of the dam) will produce an estimated water surface elevation of 440.0 immediately downstream from the embankment. This discharge will raise the water surface approximately 9.0 feet from the depth of water that occurs just prior to dam failure when the discharge is 1021 CFS. Calculations indicate that normal uniform flow, obeying Manning's formulae, will occur a distance of approximately 5000 feet downstream from the dam and the depth of flow will equal about 7.0 feet. The village of Pascoag is about 2000 feet below the impoundment. For that

distance of 5000 feet from the dam, the depth of flow will vary from 17.0 feet to 7.0 feet. This failure discharge will damage approximately thirty homes, ten commercial properties, at least three village streets and Route 100 and the overhead power and communication systems adjacent to these roadways. The failure will also cause extensive flooding within the Village of Pascoag. Calculated water surface elevations due to the failure of the dam are listed in Appendix D. The probable consequences including the prime impact areas, if the dam were to fail, are also listed in Appendix D.

PASCOAG RESERVOIR UPPER DAM
INFLOW, OUTFLOW AND SURCHARGE DATA

FREQUENCY IN YEARS	24-HOUR TOTAL RAINFALL IN INCHES	24-HOUR* EFFECTIVE RAINFALL IN INCHES	MAXIMUM INFLOW IN C.F.S.	MAXIMUM** OUTFLOW IN C.F.S.	SURCHARGE HEIGHT IN FEET	SURCHARGE STORAGE ELEVATION
10	5.0	2.6	1200	91	2.34	443.34
50	6.5	4.1	1910	223	3.69	444.69
100	7.0	4.6	2127	283	4.14	445.16
1/2 PMF	11.9	9.5	5262	1614	8.41	449.41
TEST FLOOD = PMF	21.4	19.0	10525	8246	10.17	451.17

*Infiltration assumed as 0.1"/hour

** Impoundment assumed initially full at spillway crest elevation 441.0
(top of dam = 449.0)

NOTES:

1. Q_{10} ; Q_{50} ; Q_{100} ; inflow discharges were computed by the approximate methodology of the Soil Conservation Service.
2. 1/2 PMF and the "test flood" computation are based on the Corps of Engineers instructions and guidelines.
3. The maximum capacity of the spillway without overtopping the dam (elevation 449.0) is equal to 1021 C.F.S.
4. All discharges indicated are dependent upon the continued integrity of upstream storage reservoirs.
5. Surcharge storage is allowed to overtop the dam when exceeding the spillway capacity.
6. Test flood = one PMF = 1250 CSM = 10525 CFS (D.A. = 8.42 square miles).

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

- a. Visual Observations. The visual inspection did not disclose any immediate stability problems in the dam. However, the upstream and downstream walls of the West Dike were observed to have collapsed in several locations.
- b. Design and Construction Data. There is insufficient design and construction data to permit a formal evaluation of stability.
- c. Operating Records. Several references to Pascoag Reservoir were found in the records of the Rhode Island Commission of Dams and Reservoirs for the period of time from 1883 through 1934. These records indicate that the dam was constructed in 1860, and that in several instances between 1910 and 1929, the dam and the West Dike were found to have suffered erosion damage to the point where the Commission recommended remedial action. Further, the records indicate that erosion damage was repaired and trees were removed several times during this period. The Commission was sufficiently concerned about the safety at the dam and the capacity of the spillway that restrictions were imposed on the maximum water elevation in Pascoag Reservoir.

In addition, the following statement was contained in the Commission's annual report for 1929:

"This office was advised that this year in regard to the dam that twelve or fifteen years ago the embankment settled down between the gatehouse and the spillway and was subsequently excavated down to within six feet of the bottom and forty or fifty yards of gravel were thrown into remedy the defect. Detailed information as to the cause of the settlement could not be obtained."

A 1947 report by the Rhode Island Department of Public Works simply noted the condition of the dam as "fair" - no details were provided.

The report of an April 21, 1978, inspection by the Rhode Island Department of Natural Resources reported the condition of the dam as "good" and recommended some repairs to the spillway and the removal of trees from the embankment.

- d. Post-Construction Changes. As noted above, the records indicate that in several instances erosion damage has been repaired and trees have been removed and, in one instance, a portion of the dam has been replaced.

In 1939, repairs were made to the control structure of the outlet works. (See Appendix D for record drawings.)

Subsequent to the last repairs, more erosion has occurred and trees and shrubs have been allowed to grow on the dam and on the West Dike. Continued erosion and tree growth will decrease the stability of the dam.

- e. Seismic Stability. Pascoag Reservoir Dam is in Seismic Zone 2 and hence does not require an evaluation for seismic stability, according to the Corps of Engineers' Recommended Guidelines.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

- a. Condition. Based on the visual inspection, available records of the site and past operational performance, Pascoag Reservoir Upper Dam, and its appurtenances, is judged to be in poor condition. Items of concern which must be corrected in order to assure the long term performance of this structure are listed in Sections 7.2 and 7.3.
- b. Adequacy of Information. The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data; but it is based primarily on visual inspection, past performance history and engineering judgment.
- c. Urgency. The recommendations and remedial measures described below should be implemented by the Owner within one year after receipt of this Phase I Inspection Report.
- d. Need for Additional Investigation. A comprehensive investigation is not required for this facility at this time. However, additional engineering input is required to conduct the analysis and designs outlined in Sections 7.2 and 7.3.

7.2 Recommendations

It is recommended that the Owner engage the services of an engineer experienced in the design of earth dams to conduct and implement the following recommendations:

- a. Because this dam and its appurtenances has a history of and is presently exhibiting erosion problems, designs should be developed for the installation of suitable erosion protection. Preparation of these designs should consider the suitability and reuse of the existing riprap, as necessary.
- b. The removal of the overgrowth of vegetation from the embankments should be undertaken. Particular care and planning of the removal of large diameter trees and their attendant root systems, and the restoration of the dam cross-sections by suitable backfill and compaction techniques should be programmed.

APPENDIX B-1

1. Design, Construction and Maintenance Records and Locations

a. Correspondence and Operational Records

Pascoag Reservoir Corporation
18 East Avenue
Harrisville, Rhode Island
(401) 568-2571

b. Correspondence and Inspection Reports

Department of Environmental Management
State of Rhode Island
83 Park Street
Providence, Rhode Island 02903

APPENDIX B
ENGINEERING DATA

PERIODIC INSPECTION CHECK LIST

PROJECT Pascoag Reservoir Dam DATE December 1, 1978
 INSPECTOR _____ DISCIPLINE _____
 INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - SERVICE BRIDGE</u>	
a. Super Structure	Timber Truss
Bearings	None
Anchor Bolts	None
Bridge Seat	
Longitudinal Members	Timber service bridge constructed approximately 2 years ago in apparent good condition.
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	Stained with preservative material
b. Abutment	Abutments are cut stone masonry training walls of the overflow spillway.

PERIODIC INSPECTION CHECK LIST

PROJECT Pascoag Reservoir Dam DATE December 1, 1978
 INSPECTOR _____ DISCIPLINE _____
 INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS</u>	
a. Approach Channel	
General Condition	Fair - combination of bedrock, sand and concrete apron.
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Approach Channel	See General Condition
b. Weir	
General Condition of Concrete	Satisfactory
Rust or Staining	None observed
Spalling	None observed
Any Visible Reinforcing	None observed
Any Seepage or Efflorescence	None observed
Drain Holes	None
c. Discharge Channel	
General Condition	Poor
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Trees overhanging both sides of channel
Floor of Channel	Contains debris, trees, brush, other vegetation, loose rock
d. Training Walls	
Seepage	Mortared cut stone masonry Noted at downstream end of left training wall.

PERIODIC INSPECTION CHECK LIST

PROJECT Pascoag Reservoir Dam DATE December 1, 1978
 INSPECTOR _____ DISCIPLINE _____
 INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL</u>	
General Condition of Dry Stone Masonry	Fair condition, some stonework dis- lodged, and mortar missing.
Rust or Staining	N/A
Spalling	N/A
Erosion or Cavitation	None observed
Visible Reinforcing	N/A
Any Seepage or Efflorescence	None observed
Condition at Joints	N/A
Drain Holes	None observed
Channel	None, downstream pool obscures vision.

PERIODIC INSPECTION CHECK LIST

PROJECT Pascoag Reservoir Dam DATE December 1, 1978
 INSPECTOR _____ DISCIPLINE _____
 INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - TRANSITION AND CONDUIT</u>	Outlet conduit is a 36 inch diameter cast iron or steel pipe through embankment. Not observable.

PERIODIC INSPECTION CHECK LIST

PROJECT Pascoag Reservoir Dam DATE December 1, 1973
 INSPECTOR _____ DISCIPLINE _____
 INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - CONTROL TOWER</u>	
a. Concrete and Structural	Concrete and masonry structure with sheet metal building.
General Condition	Good
Condition of Joints	Good
Spalling	None observed
Visible Reinforcing	None observed
Rusting or Staining of Concrete	None observed
Any Seepage or Efflorescence	None observed
Joint Alignment	Concrete section good.
Unusual Seepage or Leaks in Gate Chamber	Not observable
Cracks	None observable
Rusting or Corrosion of Steel	None observable
b. Mechanical and Electrical	
Air Vents	Gate mechanism has a manual operated vertical sluice gate. Appeared to be in working order.
Float Wells	
Crane Hoist	Valve not operated at time of inspection.
Elevator	
Hydraulic System	
Service Gates	
Emergency Gates	

PERIODIC INSPECTION CHECK LIST

PROJECT Pascoag Reservoir Dam DATE December 1. 1978
 INSPECTOR _____ DISCIPLINE _____
 INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE</u> a. Approach Channel b. Intake Structure Condition of Concrete Stop Logs and Slots Trash Rack	Underwater, not visible Part of Gatehouse Good None Debris accumulated inside; rack needs to be cleaned.

PERIODIC INSPECTION CHECKLIST

PROJECT Pascoag Reservoir Dam DATE December 1, 1978
 PROJECT FEATURE _____ NAME _____
 DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
<u>DIKE EMBANKMENT</u>	
Crest Elevation	109
Current Pool Elevation	100
Maximum Impoundment to Date	
Surface Cracks	None observed
Pavement Condition	Not paved, grassed, bare path on crest
Movement or Settlement of Crest	Settlement of crest ~12" in vicinity of 1+60 and 1+70
Lateral Movement	DS stone masonry wall bulging in vicinity of Sta 1+75
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Good
Indications of Movement of Structural Items on Slopes	None
Trespassing on Slopes	Vertical wall DS and US
Sloughing or Erosion of Slopes or Abutments	Erosion of walls both DS & US loss of section of walls
Rock Slope Protection - Riprap Failures	Extensive windows through riprap on US side of dam
Unusual Movement or Cracking at or Near Toes	None
Unusual Embankment or Downstream Seepage	None observed
Piping or Boils	None
Foundation Drainage Features	None
Toe Drains	None
Instrumentation System	None
Vegetation	Extensive along crest & toe

PERIODIC INSPECTION CHECKLIST

PROJECT Pascoag Reservoir Dam DATE 12-1-78
 PROJECT FEATURE _____ NAME _____
 DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
<u>DAM EMBANKMENT</u>	
Crest Elevation	111
Current Pool Elevation	100 (Assumed)
Maximum Impoundment to Date	
Surface Cracks	None observed
Pavement Condition	Not paved, grass and brush
Movement or Settlement of Crest	Possible settlement in vicinity of gate house
Lateral Movement	Possible movement at several locations on DS slope, slight bulging of slope
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Erosion of slopes adjacent to spillway structure and upstream gatehouse.
Indications of Movement of Structural Items on Slopes	None observed
Trespassing on Slopes	Animal holes and erosion on upstream face.
Sloughing or Erosion of Slopes or Abutments	Erosion evident both US & DS
Rock Slope Protection - Riprap Failures	Large windows in riprap on US slope
Unusual Movement or Cracking at or Near Toe	None observed
Unusual Embankment or Downstream Seepage	Evidence of seepage along entire DS toe on right side of spillway
Piping or Boils	None observed
Foundation Drainage Features	None
Toe Drains	None
Instrumentation System	None
Vegetation	Extensive both US and DS

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT Pascoag Reservoir Upper Dam DATE December 1, 1978

TIME 0900

WEATHER 40° F, Sunny

W.S.ELEV. 100 U.S. _____ D.S. _____

PARTY :

- | | |
|----------------------|---------------------|
| 1. <u>A. Reed</u> | 6. <u>J. France</u> |
| 2. <u>S. Khanna</u> | 7. _____ |
| 3. <u>R. Brown</u> | 8. _____ |
| 4. <u>D. Sluter</u> | 9. _____ |
| 5. <u>R. Murdock</u> | 10. _____ |

PROJECT FEATURE	INSPECTED BY	REMARKS
1. _____		
2. _____		
3. _____		
4. _____		
5. _____		
6. _____		
7. _____		
8. _____		
9. _____		
10. _____		

APPENDIX A

INSPECTION CHECK LIST

3. Areas of the West Dike where the upstream and downstream stone facing has collapsed should be temporarily repaired to prevent further erosion of the exposed soils, pending completion of the recommended restoration.
4. Seepage at the toe of the embankments should be monitored on a weekly basis. Records of the quantity of seepage, its color and solids content, the location of the exit points, as well as a photographic record should be maintained.
5. A regular program should be implemented for the recording of data such as water surface levels, discharges, time of drawdown to assist those responsible for the monitoring and operation of the structure.
6. Install new fencing and secure the gatehouse from vandalism.
7. Clear the trash racks at the outlet works and include this item as a regular feature of a continual maintenance program.
8. Temporarily repair all erosion gullies and surfaces pending the results of planned permanent restoration work.
9. Develop and post an emergency action plan including a warning system in order to prevent or minimize the impact of dam failure.
10. Continue the technical inspection of this facility on an annual frequency.

7.4 Alternatives

N/A

- c. The cause of the depression near the gatehouse should be investigated and the suitability of the materials placed in the 1912 or 1915 repair should be evaluated.
- d. The seepage on the downstream face should be investigated. A collection system should be designed so that the quantity and turbidity of the seepage can be monitored.
- e. A topographic survey should be conducted for the dam and its appurtenances in order to establish current drawings for analysis and design. As part of the survey, install survey monuments along the crest of the dam to be used in monitoring horizontal and vertical movements of the embankment.
- f. The maximum spillway and outlet works discharge capacity of the dam is not considered adequate. Further hydrologic and hydraulic studies are required to determine measures necessary to increase the discharge capabilities of the dam.
- g. The restoration of the full height and cross-section of the West Dike must be made. Stability analysis using varying reservoir conditions should be conducted to assure that the proper dike configuration is selected.
- h. A limited subsurface investigation should be conducted to ascertain the embankment materials. Additionally, the permanent installation of a few piezometers at some of the boring locations should be made to determine and monitor the phreatic surface through the embankments.
- i. The water surface level of the reservoir should be lowered to agree with the State of Rhode Island directive (See Appendix B-2, letter dated March 27, 1939) until the restoration work outlined in these recommendations is completed, and a new water surface determined based on current data.

7.3 Remedial Measures

a. Operating and Maintenance Procedures

- 1. The Owner should take such action as necessary to prevent trespass on the crest, slopes and abutments of the dam and its appurtenances, particularly on those areas subject to damaging erosion.
- 2. Brush, vegetation and trees should be removed from the spillway channel and the embankments on a regular basis.

APPENDIX B-2

Inspection Reports or Correspondence

By

April 21, 1978	Dept. of Natural Resources, State of RI
May 31, 1956	State of RI to Uxbridge Worsted Co.
May 7, 1956	Interoffice Memo, State of RI
July 16, 1947	State of RI to Uxbridge Worsted Co.
February 17, 1947	Interoffice Memo, State of RI
September 18, 1946	State of RI, Inspection Report
March 27, 1939	State of RI to Uxbridge Worsted Co.
March 25, 1939	Interoffice Memo, State of RI
December 31, 1934	Copy of Annual Report

DEPARTMENT OF NATURAL RESOURCES

PMJ

DAM INSPECTION REPORT

DAM: #16 RIVER: Pascoag River WATERSHED: Blackstone/
NAME: Pascoag Res., Upper TOWN: Burrillville (Pascoag) Branch
OWNER: Pascoag Reservoir Corp.,
c/o Marcus Thompson
18 East Avenue
Harrisville, RI 02830

REPORT ON: General Condition of the Dam

REASON FOR INSPECTION: N.P.S.I.D. High/Intermediate Hazard
Annual Inspection

INSPECTION BY:
Earle Prout
Carmine Asprinio

DATE OF INSPECTION: April 21, 1978

REPORT: Existing Conditions

Spillway: Concrete-lined stone base of spillway dry-water level at foundation of gatehouse shows at 8'6". Heavy granite block abutment walls at spillway appear to be in very good condition. There is some cracking of concrete at base of spillway (see photo #2). Spillway, and footbridge over, are in generally good condition.

Gate: Foundation of draw-off gate shows no signs of scouring of concrete. Metal sides and roof of gatehouse dented but locked and secured at this time. Parts of surrounding wire mesh fence have been torn out, apparently by vandals. Trash rack in good condition and outlet of culvert shows no signs of erosion. One large granite boulder coming out of place (see photo #3).

Embankment: Heavily lined (on pond side) with large rocks. Earthen embankment shows no signs of seepage and appears to be in generally good condition except for heavy growth of trees, especially on downstream side of bank (see photo #1).

Comments

Dam is in generally good condition. Confirming letter of inspection to owner should request patching of cracks in base of spillway and extending the amount of concrete facing on bed of entrance to spillway to prevent the future undermining of existing bed facing (see "red" arrows on photo #2), removal of trees along both sides of embankment, and repairing of fence around gatehouse to discourage future vandalism.

May 31, 1956

Uxbridge Worsted Company
Pascoag
Rhode Island

Attention: Mr. Paul E. Wenzel, Manager.

Gentlemen:

Pascoag Reservoir Dam (R. I. Dam No. 16)
Pascoag River
Burrillville, R. I.

Several complaints have recently been received at this office from owners of property along the shore of Pascoag Reservoir (also known as Echo Lake) in the Town of Burrillville. The complainants are protesting against the low-water level at which the reservoir is now being operated and have stated that, because of this condition, unsightly mud flats have been exposed around the front of their property, and some of their piers have been made useless for berthing their boats because of lack of water.

In looking through our records we find that in 1934 a schedule of water-level control was proposed for your reservoir in order that all having interest therein might be satisfied. In view of this and also because this is the first time that protests have reached us for some time, we request that you inform this office whether your operation of the reservoir this year has been different from other years, and the reason for the change.

Any information you can give us in this regard, and also any effort you can make to restore the water level to satisfy the shore owners will be appreciated.

Very truly yours,

Henry Isé, Chief
Division of Harbors & Rivers

H:mp

c.c. Joseph M. Vallone, Director, Dept. of Public Works

May 7, 1956

TO: Mr. Henry Isé, Chief
FROM: John W. Kelly
SUBJECT: Echo Lake water elevations
(Pascoag Reservoir Dam #16)

I visited Echo Lake (south end of Pascoag Reservoir) and noted low water conditions at this end of reservoir today (see pictures). Tony Caccia was with me. We then visited Dam at north end of Pascoag Reservoir and noted elevations on a water gage painted on the side of gate house foundation. Reviewing records, we find that the maximum allowable height of water = Elev. 441.00 - was determined by Mr. O. F. Garle in 1939 & 1943 (see letters in file) about 4'0" below spillway elevation = 445.01. See also letter of March 27, 1939 ordering same elevation. Water elevation today = 440.5. This is therefore within 6" of maximum allowable height of water in reservoir.

There are records of several efforts to raise the level of water in this reservoir and apparently it was agreed between Edward L. Greene, Commissioner of Dams & Reservoirs and the Pascoag Reservoir Association (as reported on p. 16 of the Annual Report ending December 31, 1934) upon an operating schedule as follows:-

July 16, 1947.

Mr. George Lister, Master Mechanic,
c/c Uxbridge Worsted Company
Pascoag, R. I.

Re: Pascoag Reservoir #16

Dear Mr. Lister:-

On a recent inspection at the Pascoag Reservoir #16, the following items were observed as needing attention in order to keep the reservoir in good operating condition:

1. Trees on north bank of main dam need cutting.
2. West embankment is overgrown with trees and brush and retaining walls are down in places.

We would recommend that these items have your early attention.

Yours very truly,

DIVISION HARBORS AND RIVERS

Frank M. O'Donnell, Chief.

By John V. Kelly, Engineer.

State of Rhode Island
INTER-DEPARTMENTAL COMMUNICATION

February 17, 1947.

TO Frank M. O'Donnell, Chief,
DEPT. Public Works (Harbors and Rivers)
FROM John V. Kelly, Engineer,
DEPT. Public Works (Harbors and Rivers)
SUBJECT: Pascoag and Wilson Reservoirs.

John V. Kelly
Adm.

Anticipating Spring floods, I checked Pascoag and Wilson Reservoirs on Saturday, February 15th, 1947, and found both in good condition to receive any sudden rise of water-level behind the dam. The surface of both ponds was practically 2 feet below the required elevation.

Observations were made as follows and noted in respective records:

Pascoag Reservoir #16

Pond was 6'6½" below concrete platform at draw-off gate house (-4'9" required). Draw-off gate open. Brush not cut on north slope as yet. Pond open; very little ice except on edges.

Wilson Reservoir #3

Pond was 60" plus below first concrete step at draw-off culvert (-26" required). Draw-off gate open 6" plus. Pond clear of ice except on edges.

John V. Kelly
John V. Kelly.

DAM NO. 15

INSPECTED BY

J. V. KEILY

WATERSIDE BLACKSTONE -

REPORT ON-NEW CONSTRUCTION
PLANS BY

REPAIRS

INSPECTION ONLY X

APPROVED

CONTRACTOR

TICKLER

SPILLWAY

TYPE

CONDITION

DRAW-OFF GATES

NUMBER

CONDITION

TRENCHES & WHIFELS

EMBANKMENT

TYPE

CONDITION

APPROACHES

EROSION

BRUSHES & TREES

RIPRAP

PRESENT USE

WTIO CONTROLS

WHO CONTACTED
AT SITE

INSTRUCTIONS LEFT

IN EMERGENCY
CALL

INSPECTION REPORT BY JOHN V. KELLY REASON ROUTINE

DATE 9/18/40

EMERGENCY: 1: GEO. LISTER, MASTER MECH. UXBIDGE WORSTED CO. PASCOAG, 123 SABLE AVENUE
2. F. LED KENNEY, GENERAL MANAGER AT MILL TELL PASCOAG 350 TEL PAS 245-
9/18/46 CONDITION FAIR. HIGH EARTH DAM (15'-18' AT TOP) RETAINING LARGE RESERVOIR. WATER
HEIGHT LIMITED TO GET PROPER FREEBOARD AND ADVANTAGE OF RIPRAP (3' ABOVE SPILL TO-DAY). WATER
LEVEL 50" BELOW CONCRETE ~~SPILL TO-DAY~~ ^{SPILL TO-DAY} (4'-9" REQUIRED). MASONRY SPILLWAY AT WEST END OF DAM
IN EXCELLENT CONDITION. UNWAD-OFF CONTROLLED BY GATEHOUSE AT CENTER OF DAM IN EXCELLENT CONDI-
TION AND UNDER CONTROL OF UXBIDGE WORSTED MILL (2000' BELOW) ON SAME STREAM. HEAVY GROWTH OF
TREES ON NORTH SLOPE OF EMBANKMENT SHOULD BE CUT. MASTER MECHANIC OF UXBIDGE WORSTED, PASCOAG
SO NOTIFIED. GROWTH TO BE CUT YEARLY. 9 1/2' FREEBOARD TO-DAY. DAM OWNED BY PASCOAG RESERVOIR
ASSOCIATION, BUT GATES ARE WORKED BY UXBIDGE WORSTED COMPANY. WATER USED FOR PROCESSING
AND FIRE PREVENTION (NO WHEELS IN MILL AT PRESENT). ANOTHER DIKE FURTHER WEST IS PART OF
EMBANKMENT RETAINING THIS PASCOAG RESERVOIR. IT IS GENERALLY IN GOOD CONDITION BUT RETAINING
WALLS ARE DOWN IN A FEW PLACES AND TREES ON EMBANKMENT SHOULD BE CUT DOWN YEARLY. SO RE-
QUESTED OF MR. LISTER.
3/10/47-WATER SURFACE 72" BELOW CONCRETE PLATFORM AT GATE (4'7" REQUIRED). DRAWOFF GATE
PRACTICALLY CLOSED TO-DAY-ONLY RIPLE IN POND BELOW-THIN ICE ON POND; OPEN AROUND EDGES.
6/10/47-27" BELOW CONCRETE PLATFORM (4'7" REQUIRED). GATE OPEN.
5/31/48-75" BELOW PLATFORM TO W.L. (4'-9") REQUIRED) GATE WILL OPEN - BOILING INTO POND BELOW
PLANK ON PLATFORM REPAIRED.
5/13/50-INFORMATION RECEIVED TODAY THAT MARCUS THOMPSON, C/O STILLWATER WORSTED CO., OF
HARRISVILLE, R.I. IS PRESIDENT OF THE PASCOAG RESERVOIR ASSN. AT THE PRESENT TIME. UXBIDGE
WORSTED STILL OPERATES THE DAM. MR. PAUL J. BENZEL IS MANAGER OF THE PLANT AT THE PRESENT
TIME. HE WOULD LIKE TO HAVE A COPY OF THE 1937 AGREEMENT FOR GUIDANCE IN OPERATING THE DAM.
SEE LETTER TO BENZEL ON THE OPERATION SCHEDULE. J.Y.K.

4. ...
CPL [Signature]

March 27, 1939

Uxbridge Woolen Company
Pascoag, Rhode Island

Attention: Mr. Kenney

Dear Sir:-

We are enclosing permit to do the proposed work on the Pascoag Water Supply Reservoir and the work on the canal at the mill on the lower pond as shown by your plans and specifications accompanying the application.

It will be necessary to maintain at all times the level of the reservoir at an elevation not above four (4') feet below the elevation of the spillway and that the gates shall be operated so that the pond level shall be maintained at or below elevation 441.

This proviso has been inserted in the permit.

Very truly yours,

CHIEF OF HARBORS AND RIVERS

STATE OF RHODE ISLAND
DEPARTMENT OF PUBLIC WORKS

OFFICE OF DIRECTOR

State Office Building

Providence, R. I.

INTER-DIVISIONAL CORRESPONDENCE

To: Robert C. Lynch, Chief
of Harbors & Rivers

Date: March 25, 1939

From: Frederick V. Waterman
Director of Public Works

Subject: Repairs of Pascoag
Reservoir Dam

Dear Sir:

I have looked over the plans and specifications accompanying application and permit for repairs of Pascoag Reservoir Dam in Burrillville and have also looked over your comments pertaining thereto.

I approve the proposed work on the race ways at the lower dam and also approve the work around the gate house at the upper dam.

I do not disapprove of the proposed work on the spill way of the upper dam, but I do not consider that the work proposed on the spill way is sufficient that we can relieve the Pascoag Reservoir Association from requirement that the water in the Reservoir shall not be permitted to rise to an elevation higher than 4 feet below the elevation of the spill way, and that the gates shall be operated so that the water shall be maintained below that elevation.

Very truly yours,

Frederick V. Waterman

Frederick V. Waterman
Director of Public Works

FVW:FT

STATE OF RHODE ISLAND
COPY OF ANNUAL REPORT OF THE COMMISSIONER OF DAMS AND RESERVOIRS
FOR THE YEAR ENDING DECEMBER 31, 1934

PASCOAG RESERVOIR

Pascoag River

Burrillville

Tributary to Branch River

The reorganization of the association that controls the important reservoir which was referred to in last year's report, has progressed to a point where a pronounced improvement has been observed in the management of the flow of this stream.

A new schedule of water levels has been tentatively approved by this department and which is conditional upon it's rigid observance is as follows:

PERIOD	MAXIMUM ALLOWABLE HEIGHT	NEW ELEVATION *
April 15 - August 15	3'0" below spillway	442.0 *
August 15 - October 15	5'0" " "	440.0
October 15 - November 15	6'0" " "	439.0
November 15 - December 15	6'6" " "	438.5
December 15 - February 15	7'0" " "	438.0
February 15 - March 15	6'0" " "	439.0
March 15 - April 15	5'0" " "	440.0

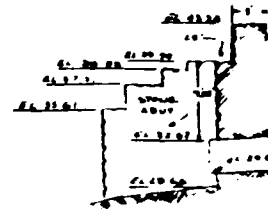
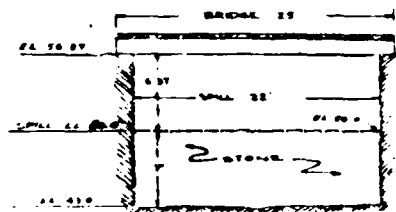
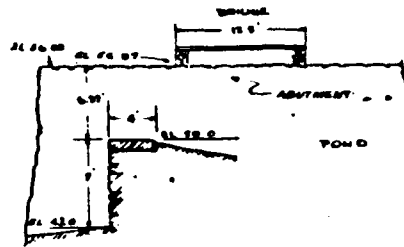
The above schedule has proved to be a success since last spring and has worked out to the mutual satisfaction of all concerned. The maximum head allowed between October 15 and April 15 affords better flood protection than was in effect heretofore while the 3'6" level allowed from April 15 to August 15 permits an increase of storage at a period when danger from high water is considerable less than during the balance of the year.

Note

These new elevations were not included in the original report but have been added to tie the adjustments of the water level in the pond to an elevation of the spillway of 445.00 as given on repair plans dated 3/6/39.

APPENDIX B-3

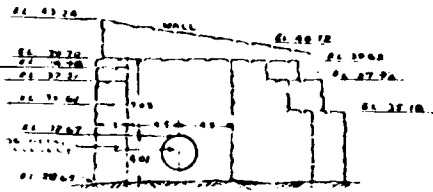
RECORD DRAWINGS



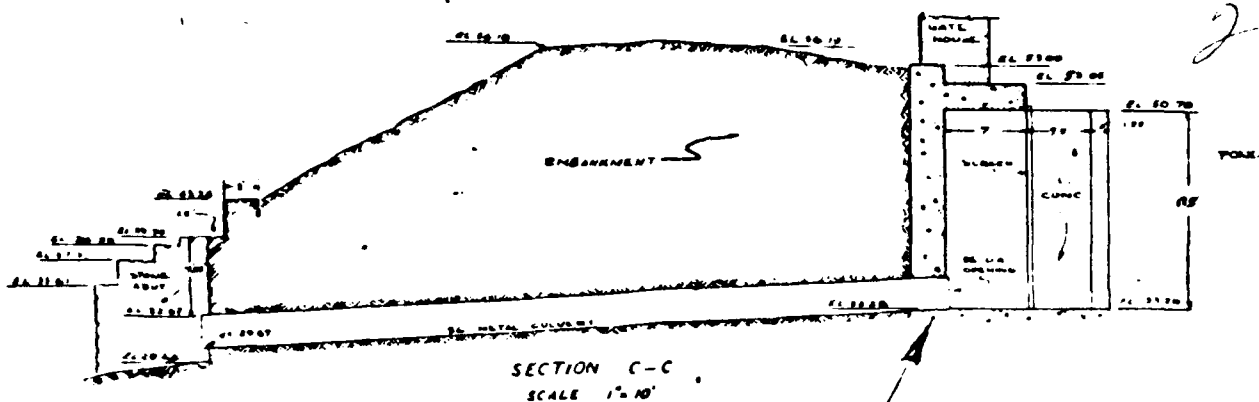
ELEVATION OF SPILL D-D
SCALE 1"=10'

FOR
GATE
AND

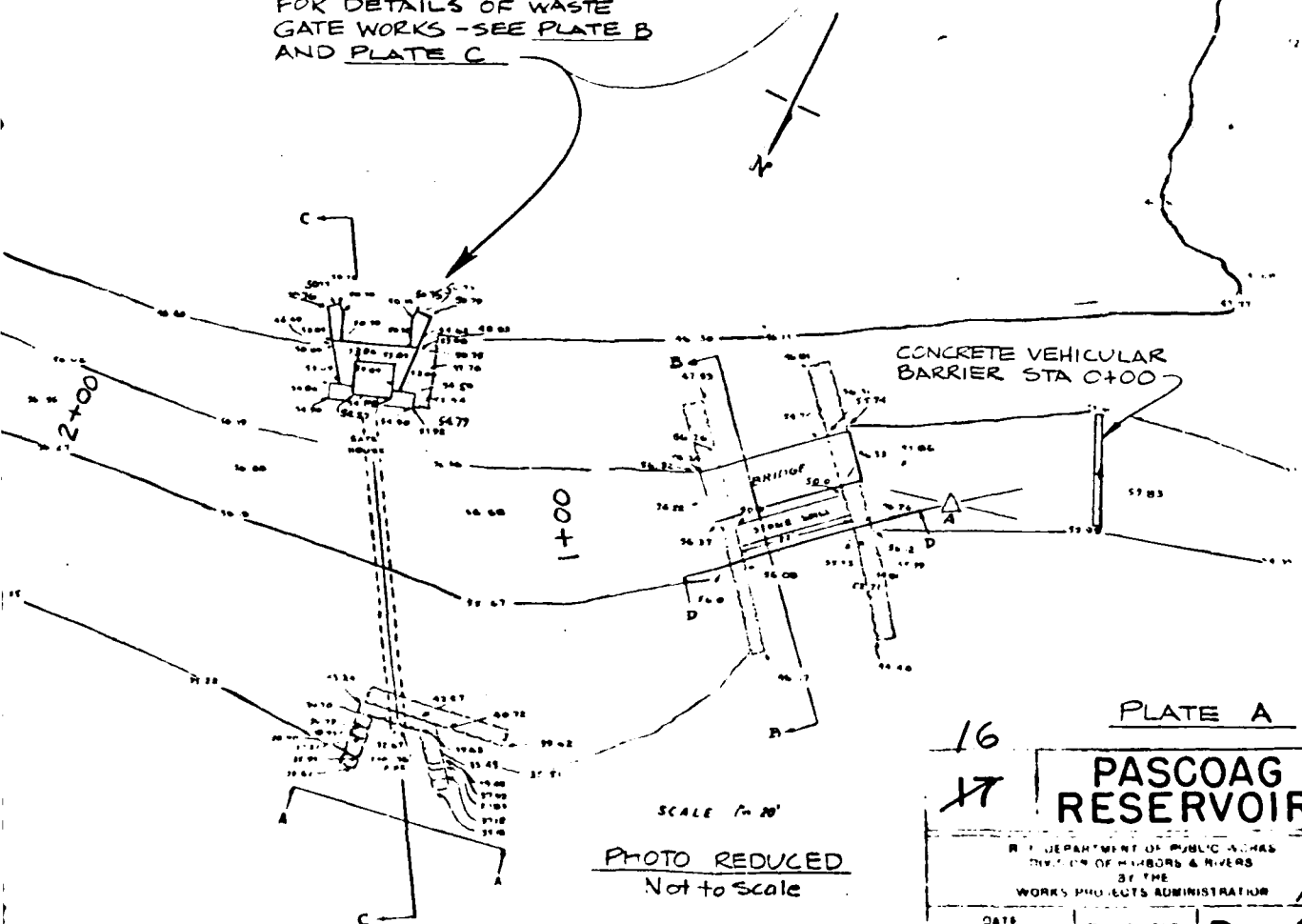
CONCRETE VEHICULAR
BARRIER STA 3+75



ELEVATION A-A
SCALE 1"=10'



FOR DETAILS OF WASTE
GATE WORKS - SEE PLATE B
AND PLATE C



SCALE 1"=20'
PHOTO REDUCED
Not to scale

16
17
PLATE A

PASCOAG
RESERVOIR

R. I. DEPARTMENT OF PUBLIC WORKS
DIVISION OF HARBORS & RIVERS
BY THE
WORKS PROJECTS ADMINISTRATION

DATE

12-8-40
PA 47 WEL

PLAN NO.

B-17

16

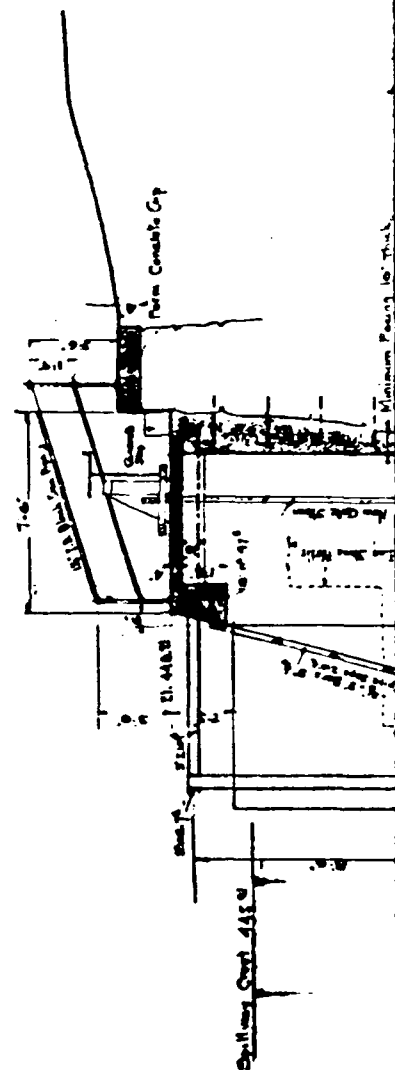
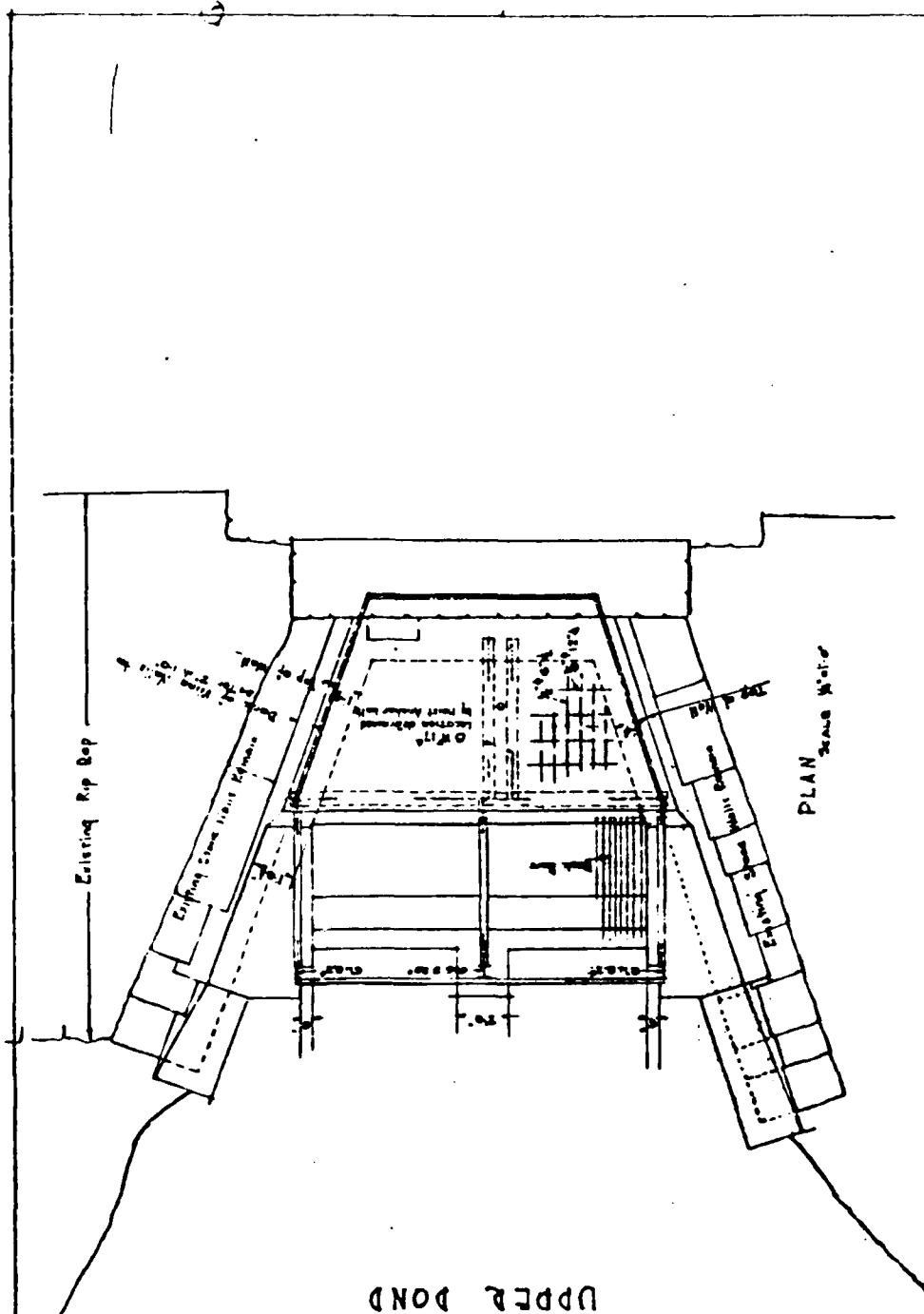


PHOTO REDUCED
Not to Scale



C-11 UPSTREAM FACE OF DIKE SECTION - LOOKING FROM LEFT
ABUTMENT



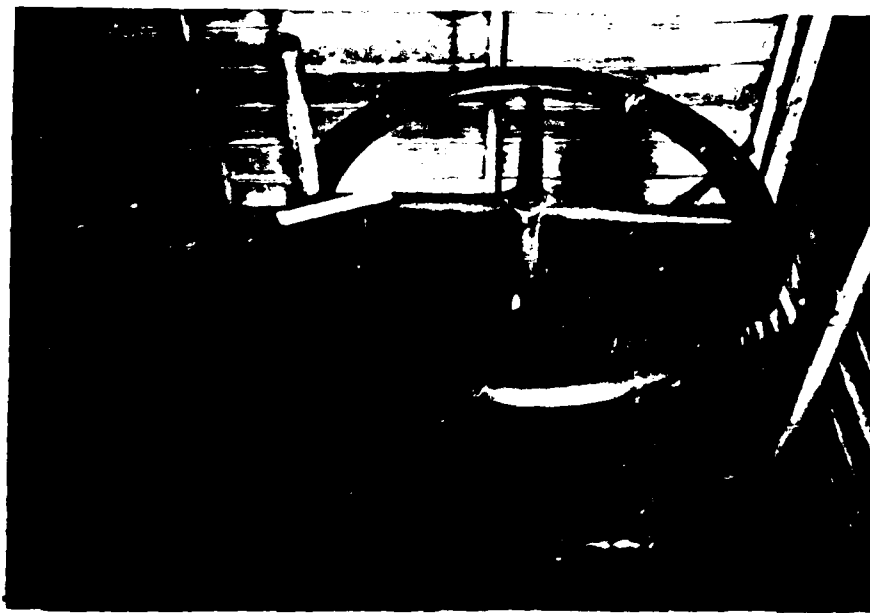
C-12 UPSTREAM FACE OF DIKE SECTION - LOOKING FROM RIGHT
ABUTMENT



C-9 OVERFLOW WEIR SECTION OF SPILLWAY



C-10 DOWNSTREAM SLOPE OF DIKE SECTION



C-7 CONTROL MECHANISM WITHIN GATEHOUSE



C-8 OVERFLOW SPILLWAY SECTION - LOOKING DOWNSTREAM



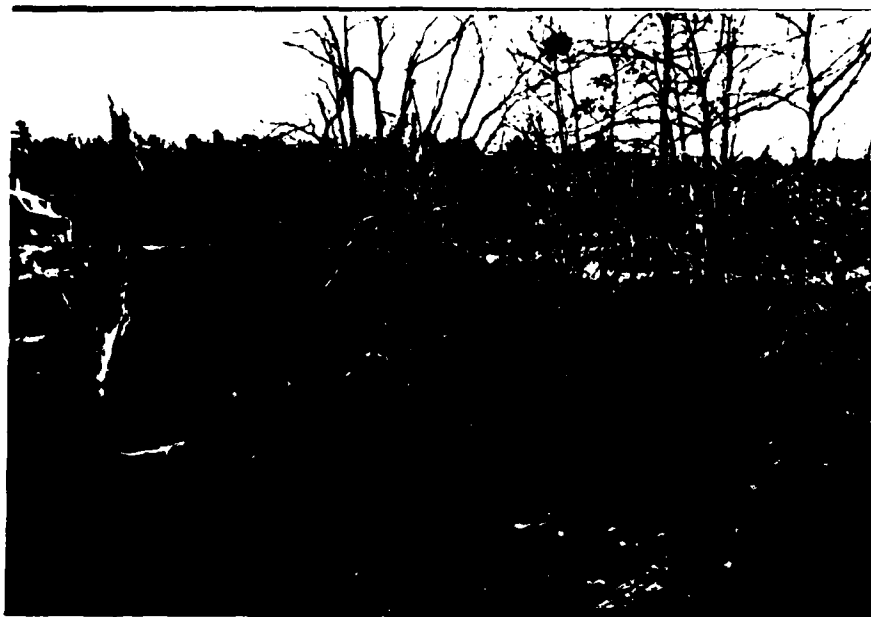
C-5 CREST OF DAM - LOOKING FROM RIGHT ABUTMENT



C-6 GATEHOUSE CONTROL STRUCTURE



C-3 DOWNSTREAM SLOPE OF MAIN EMBANKMENT - LOOKING FROM
RIGHT ABUTMENT AREA



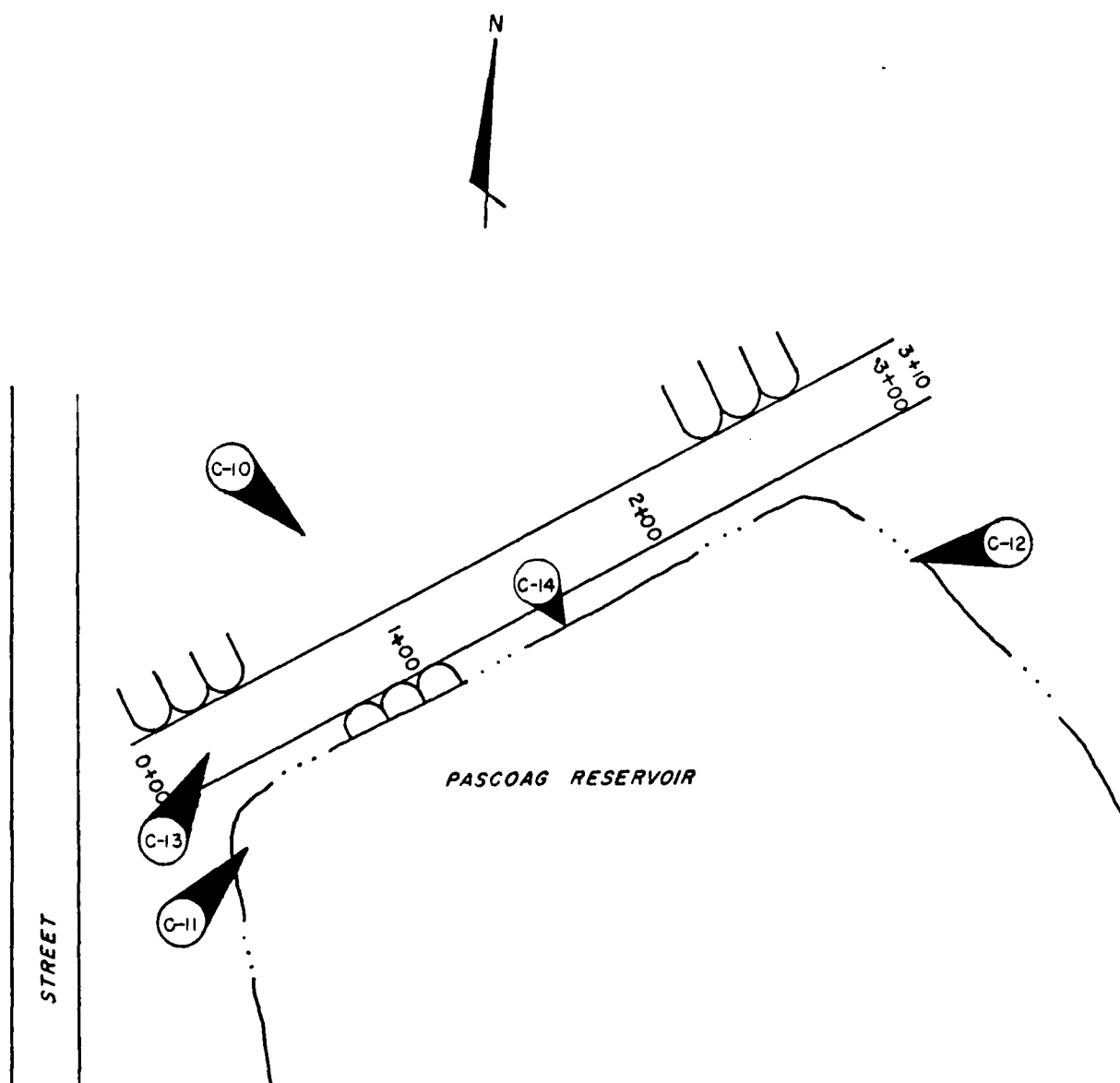
C-4 DOWNSTREAM SLOPE OF MAIN EMBANKMENT - LOOKING FROM
LEFT ABUTMENT AREA



C-1 UPSTREAM SLOPE OF MAIN EMBANKMENT - LOOKING FROM
LEFT ABUTMENT



C-2 UPSTREAM SLOPE OF MAIN EMBANKMENT - LOOKING FROM
RIGHT ABUTMENT

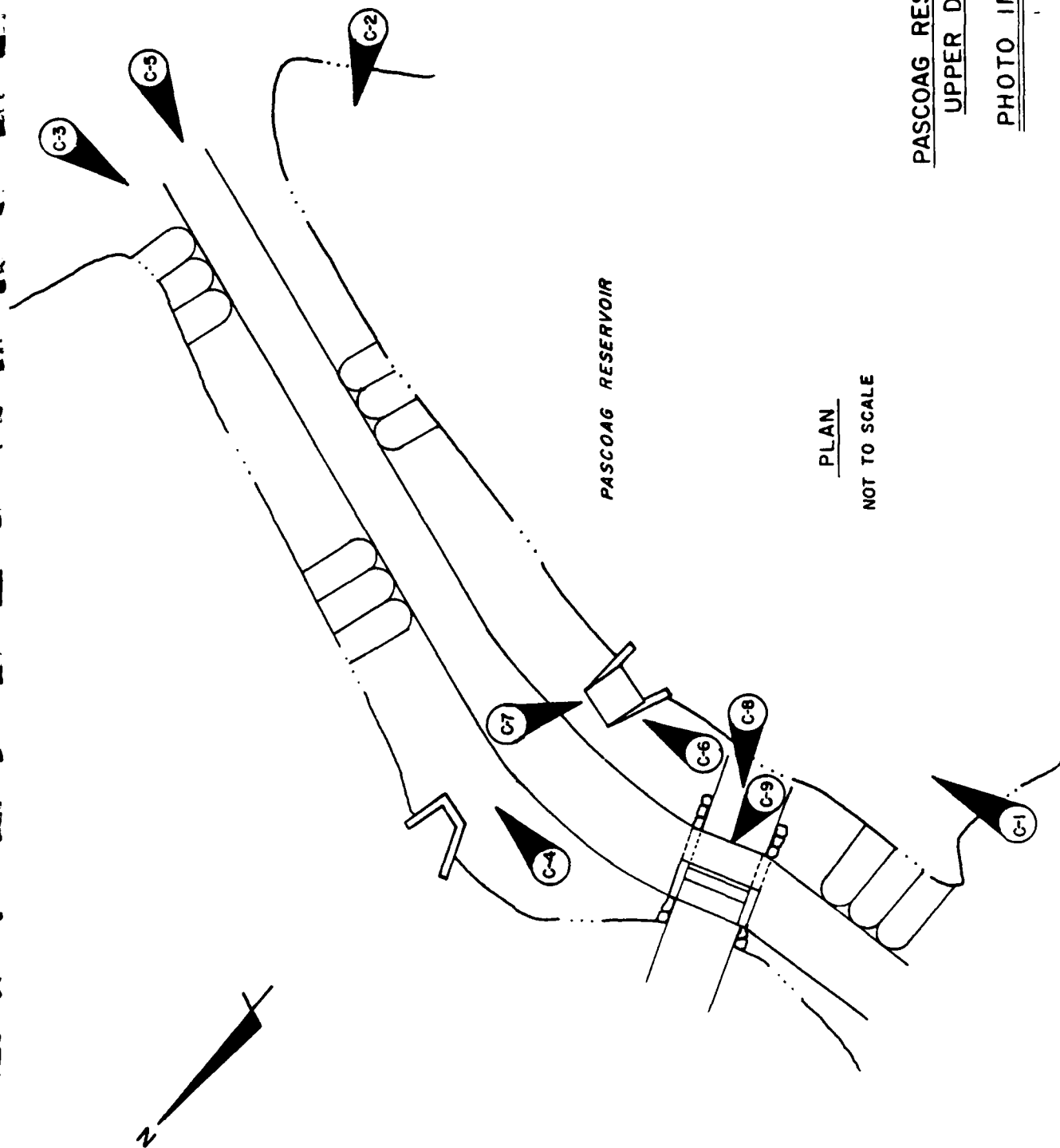


PLAN

NOT TO SCALE

PASCOAG RESERVOIR
DIKE

PHOTO INDEX



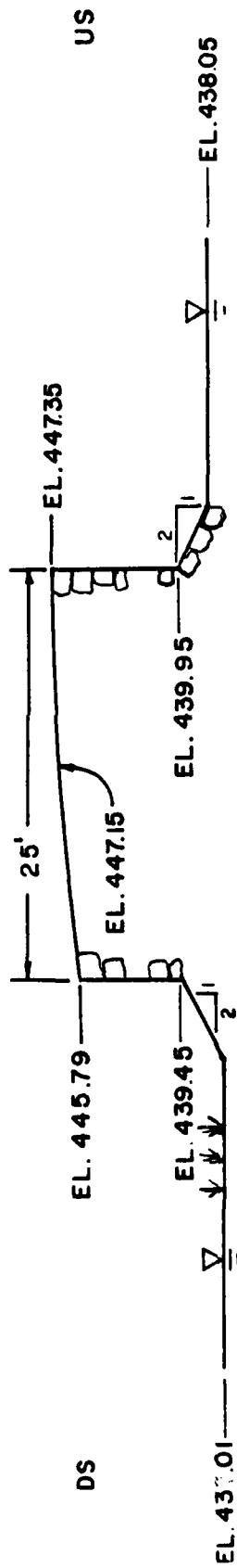
PASCOAG RESERVOIR
UPPER DAM

PHOTO INDEX

PLAN
NOT TO SCALE

APPENDIX C

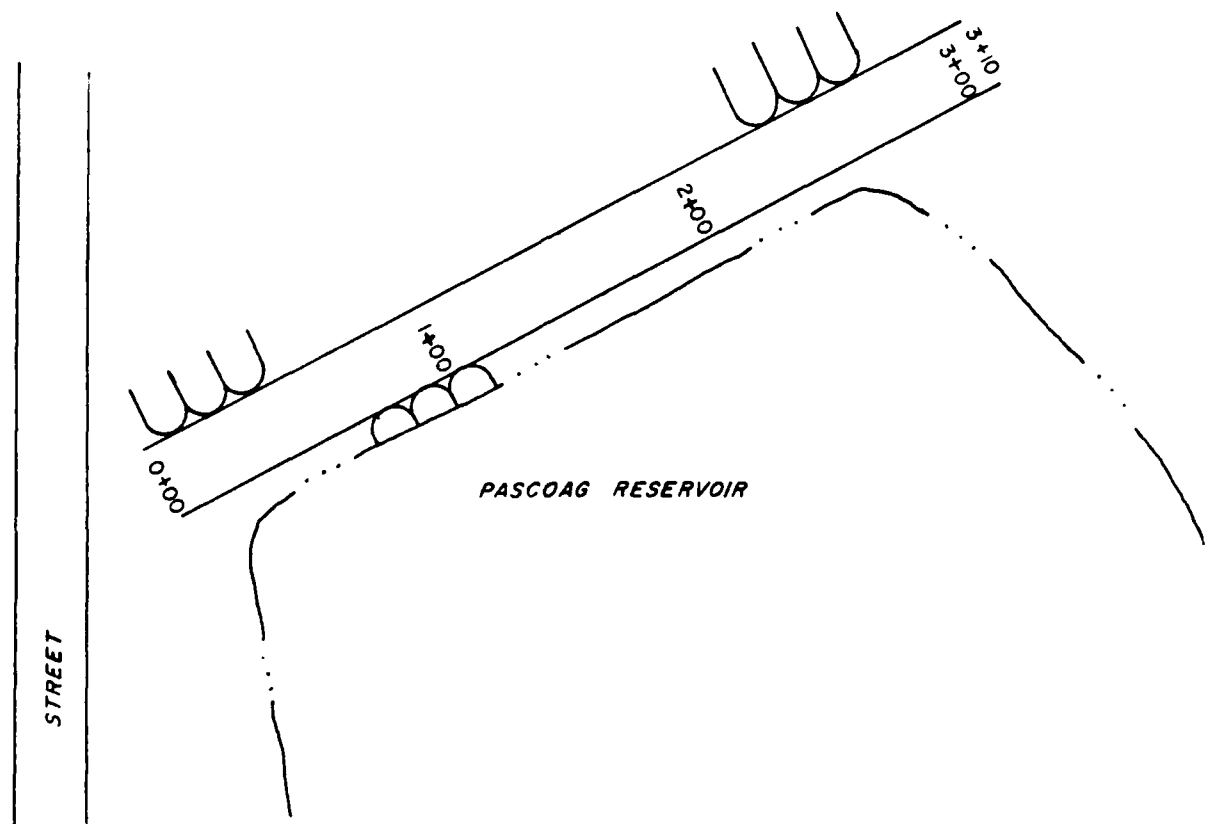
PHOTOGRAPHS



STATION 1+50

SCALE: 1"=1'

PASCOAG RESERVOIR
DIKE
TYPICAL CROSS-SECTION

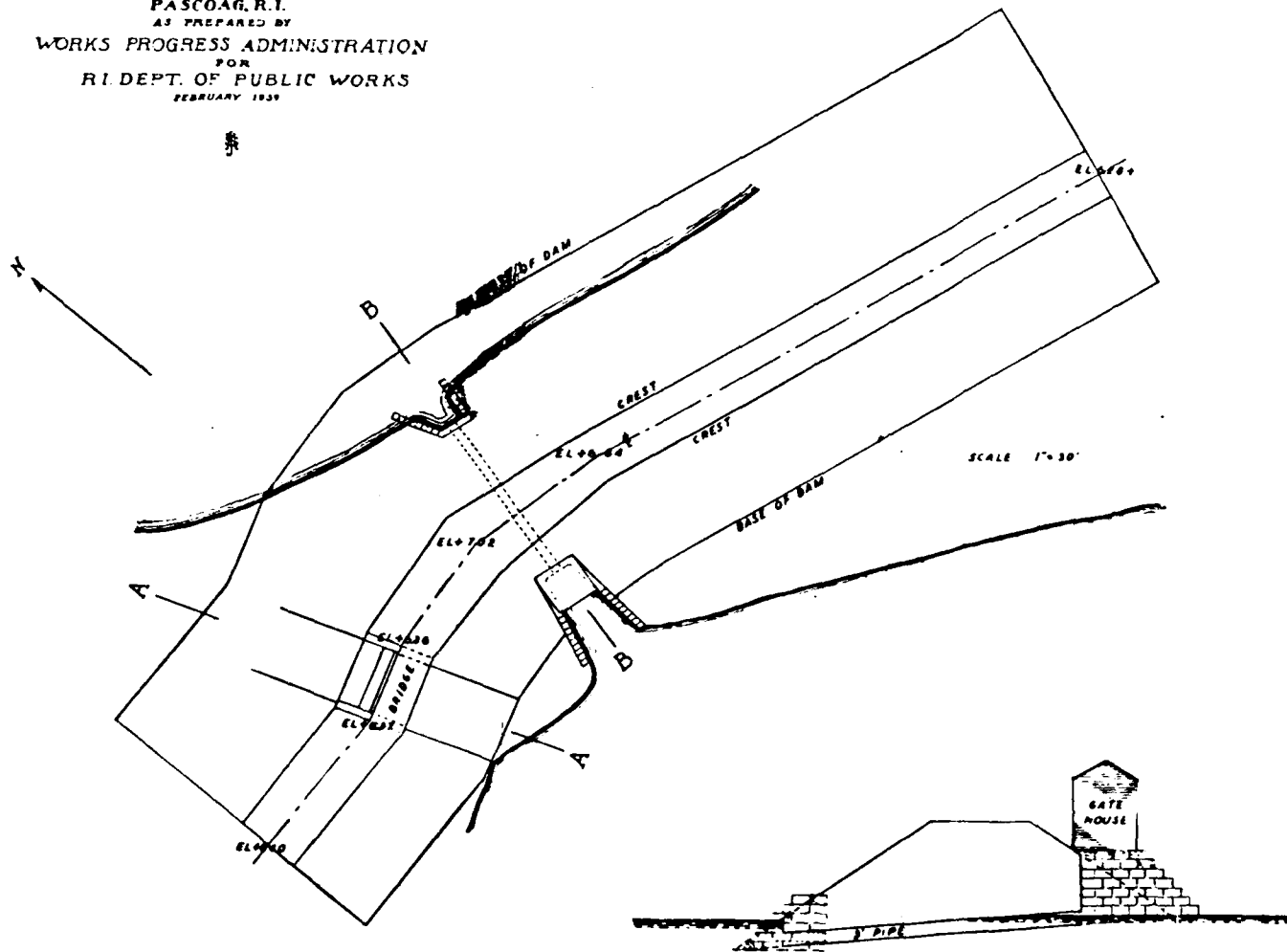


PLAN

NOT TO SCALE

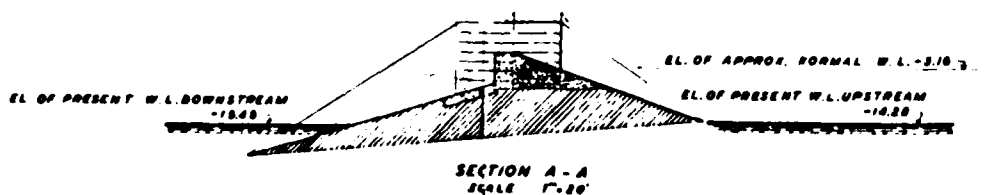
PASCOAG RESERVOIR
DIKE

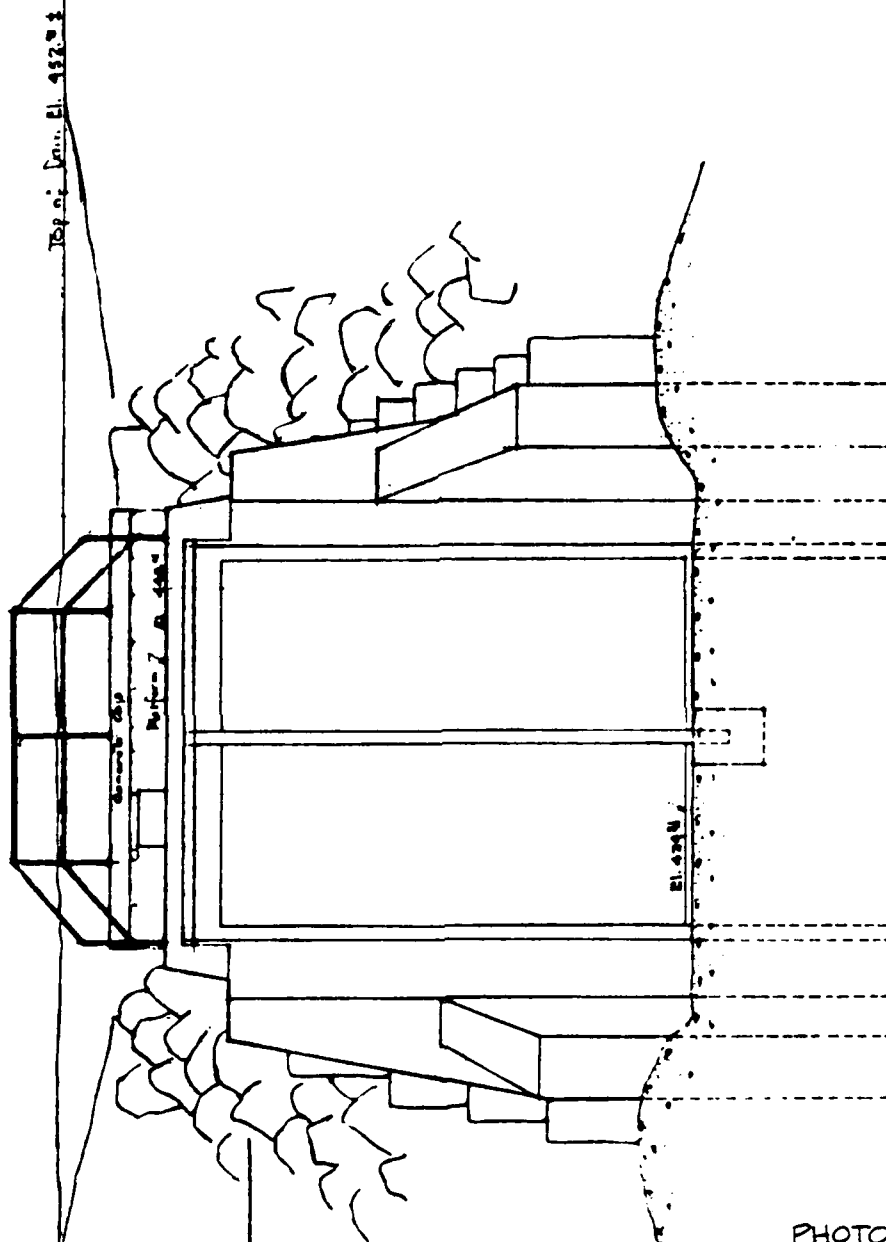
PLAN OF DAM
AT
PASCOAG RESERVOIR
PASCOAG, R.I.
AS PREPARED BY
WORKS PROGRESS ADMINISTRATION
FOR
R.I. DEPT. OF PUBLIC WORKS
FEBRUARY 1939



NOTE: EL. CREST OF SPILLWAY 0.00
ABOVE MEAN SEA LEVEL 445.04

SECTION B-B
SCALE 1"=20'





ELEVATION
Scale 1/4"=10'

PHOTO REDUCED
NOT TO SCALE

WASTE GATE WORKS
DASCOAG WATER SUPPLY RESEVOIR
UXBRIDGE WORSTED CO.

DASCOAG - RHODE ISLAND
E. J. CROSS CO., ENGRS & CONTS - WORCESTER, MASS.
DRAWING # 39-2 JOB # 1120 MARCH 6, 1929

PLATE

2

PLAN
Scale N=1"=10'

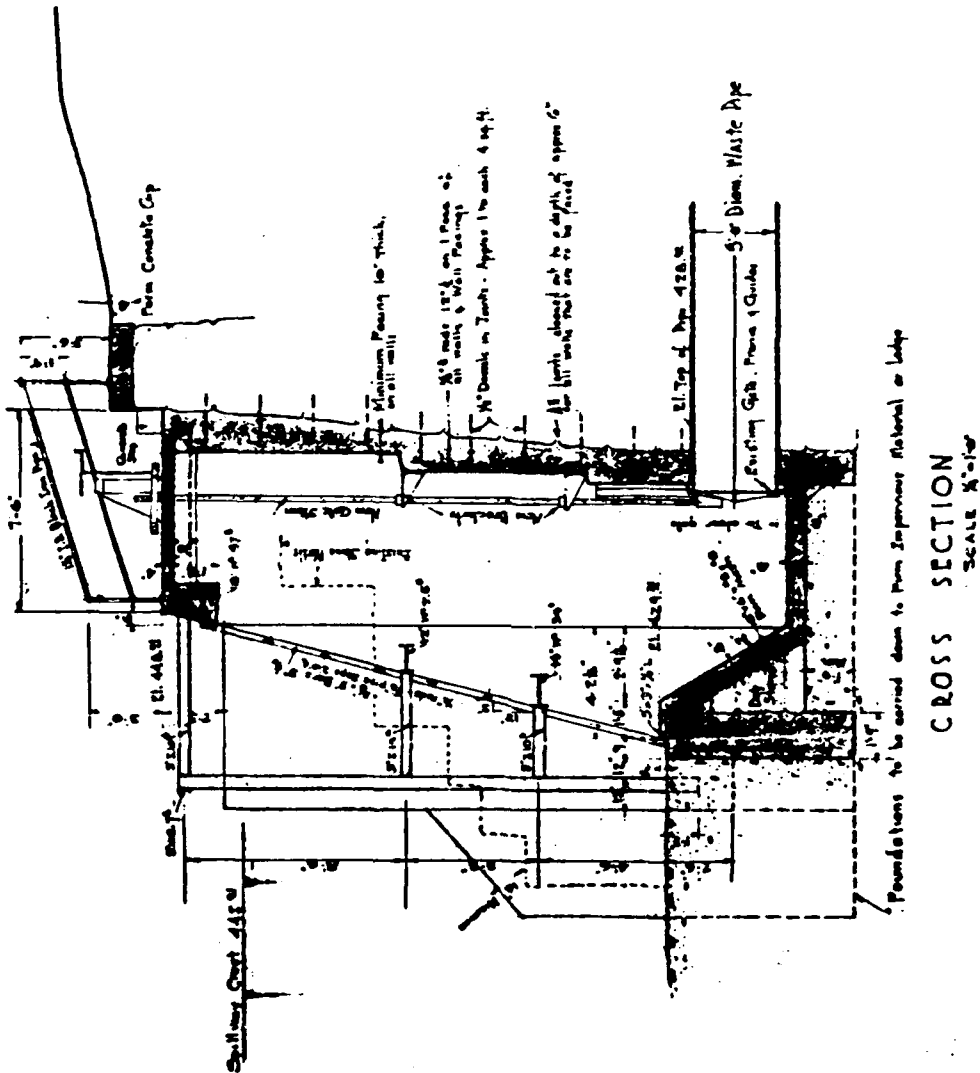


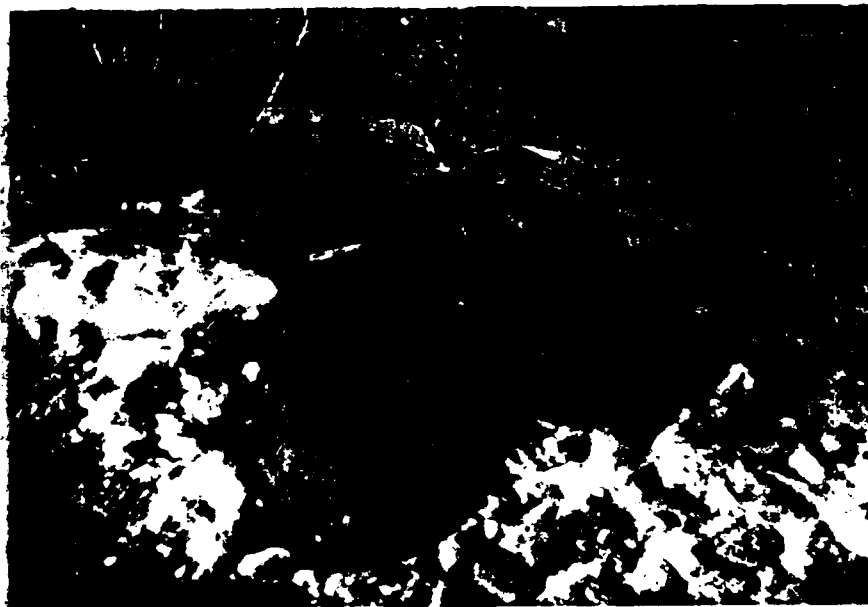
PHOTO REDUCED
Not to Scale

WASTE GATE WORKS
DASCOAG WATER SUPPLY RESERVOIR
UXBRIDGE WORSTED CO.
DASCOAG - RHODE ISLAND
E. J. CROSS CO. ENGINEERS & CONTRACTORS - WORCESTER, MASS.
DRAWING # 29-1 JOB # 1120 MARCH 8, 1929

PLATE B



C-13 CREST OF DIKE EMBANKMENT

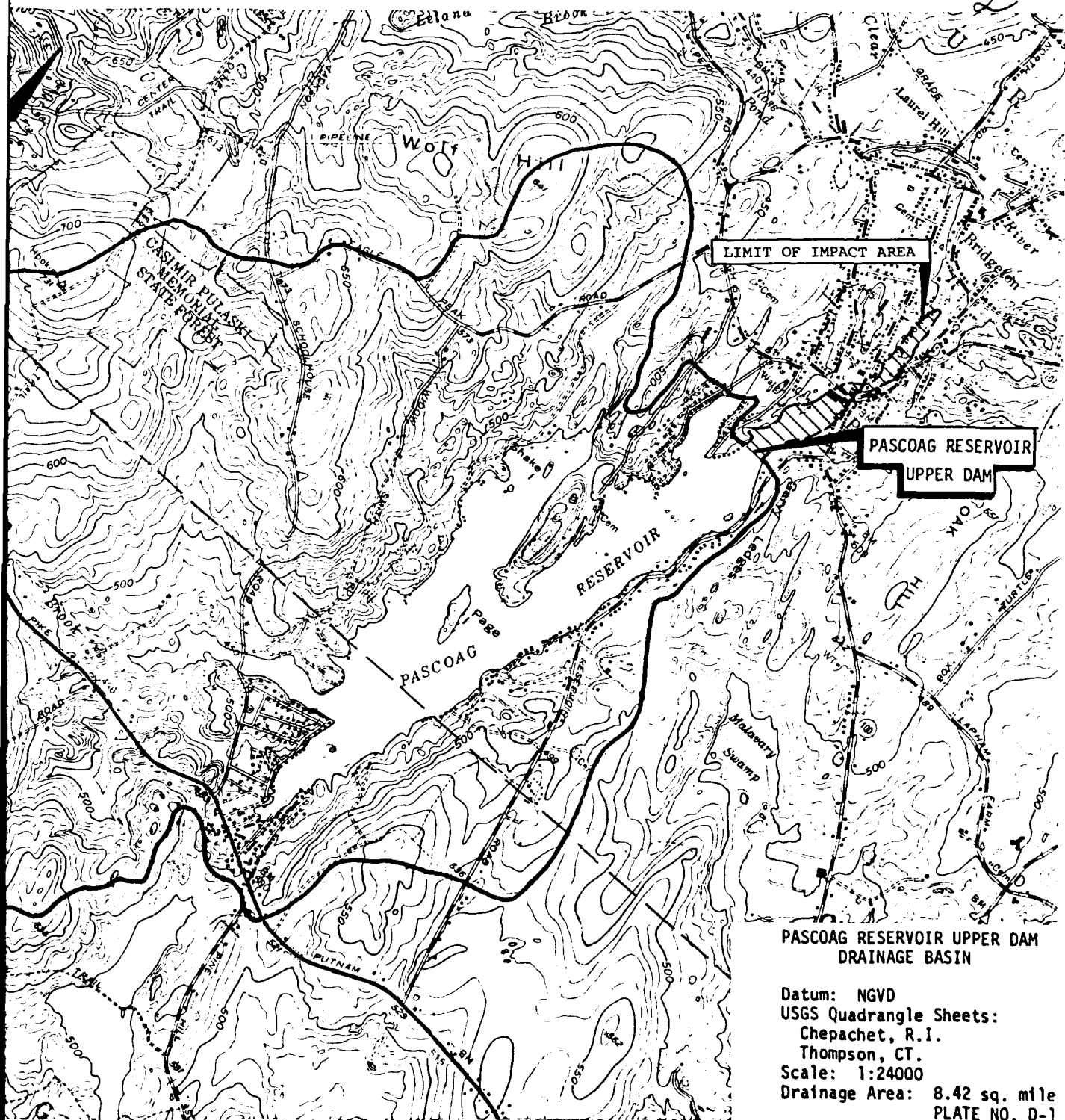


C-14 EROSION ON FRONT SLOPE OF DIKE EMBANKMENT

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS





Estimating Maximum Probable Discharges - Inflow and Outflow Values Date of Inspection: 12/1/78

Name of Dam Pascoag Reservoir Upper Dam, Location of Dam Brandy Brook, Town Pascoag, RI

Watershed Characterization Moderately steep; upstream storages; with neglig- 0.42 sq. miles of drainage area
ible swamps. is swampy or occupied by storage
reservoirs

Adopted "test" flood = Full PMP = 1250 CSM = 10525 CFS; Re = Effective Rainfall = 19.0 inches

D.A. = Drainage Area (Gross) = 8.42 Square Miles; Basin Slope = 0.04 ± hence; Moderately Steep

S.A. = Surface Area of Reservoir = 0.78 Square Miles; Time of Concentration is more than 120 minutes

Shape and Type of Spillway = Overflow; Broad-crested, concrete lined stone base; granite abutments with footbridge.
Upstream sloping; downstream vertical overfall.

B = Width of Spillway = 21.0 feet; C = Coefficient of Discharge = (3.09-Friction) = 3.00

Maximum Capacity of Spillway Without Overtopping = 1021 CFS = 9.7 % of test flood Inflow
Top of Dam Elevation = 449.0, Spillway Crest Elevation = 441.00 12.4% of test flood Outflow

Overflow portion of Length of Dam = 750 feet, C = Coefficient of discharge for Dam = 3.00

Name of Dam	Test Flood		Inflow Characteristics		Outflow Characteristics First Approximation				Outflow Characteristics Second Approximation				Outflow Characteristics Third Approximation (Adopted)			
	Qp CFS	CSH	h0 in feet	S0 in in.	Qp1 CFS	h1 in ft.	S1 in in.	S2 in in.	h2 in ft.	Qp2 CFS	S3 in in.	h3 in ft.	Qp3 CFS			
1	2	3	4	5	6	7	8	9	10	11	12	13	14			
Pascoag Reservoirs	PMP = 1250	10525	10.61	11.79	10525	10.61	11.79	11.30	10.17	8246	11.3	10.17	8246			
	1/2 PMP = 625	5262	9.53	10.59	5262	8.54	9.5	9.34	8.41	1614	9.34	8.41	1614			

Qp = Discharge; h = Surge height; S = Storage in inches NOTE: Outflow discharge values are computed as per COE guidelines.
Note: It is assumed that dike is maintained at crest elevation of dam (449.0).

A. Size Classification

Pascoag Reservoir Upper Dam

Height of dam = 27.0 ft.; hence Small

Storage capacity at top of dam (elev. 449.0 = 9000 AC-FT.; hence Intermediate

Adopted size classification Intermediate

B.i) Hazard Potential

Pascoag Reservoir Dam has a high hazard potential, since it is located upstream of industrial buildings, the highly populated village of Pascoag and a network of several roads across the Pascoag River where the failure discharge is likely to flow.

ii) Impact of Failure of Dam at Maximum Pool (Top of Dam)

It is estimated from the rule of "thumb" failure hydrograph, that the following adverse impacts are a possibility by the failure of this dam.

- a) Loss of life Yes ; 1 to 30 lives can be lost.
- b) Loss of homes Yes ; 1 to 30 homes can be lost.
- c) Loss of buildings Yes ; 1 to 10 buildings can be lost.
- d) Loss of highways or roads Yes ; 3 roads can be damaged.
- e) Loss of bridges Yes ; 1 to 4 bridges can be lost.
- f) Miscellaneous Yes ; Loss of utility services to town of Pascoag.

The failure profile can affect a distance of 5000 feet from the dam. For water surface elevation, see next page in Appendix D.

C. Adopted Classifications

<u>HAZARD</u>	<u>SIZE</u>	<u>TEST FLOOD RANGE</u>
<u>High</u>	<u>Intermediate</u>	<u>Full PMF</u>
Adopted Test Flood = <u>One</u>	PMF = <u>1250</u>	CSM
	= <u>10525</u>	CFS

D. Overtopping Potential

Drainage Area	= <u>8.42</u>	sq. miles
Spillway crest elevation =	<u>441.0</u>	NGVD
Top of Dam Elevation =	<u>449.0</u>	CFS
Maximum spillway discharge		
Capacity without overtopping of dam =	<u>1021</u>	CFS
"test flood" inflow discharge =	<u>10525</u>	CFS
"test flood" outflow discharge =	<u>8246</u>	CFS
% of "test flood" overflow carried by spillway without overtopping =	<u>12.4%</u>	
"test flood" outflow discharge portions which overflows over the dam =	<u>7225</u>	
% of test flood which overflows over the dam =	<u>87.6%</u>	

Mill Pond is located just downstream of Pascoag Reservoir Upper Dam. Valley storage between Pascoag Reservoir Upper Dam and Mill Pond is not significant in reducing the discharge. The approximate water surface elevation difference between Pascoag Reservoir Upper Dam and Mill Pond is 10 feet. The increase of depth in Mill Pond due to failure of Pascoag Reservoir Upper Dam is estimated to be 9.0 feet.

"Rule of Thumb Guidance for Estimating
Downstream Dam Failure Discharge"

BASIC DATA

Name of dam Pascoag Reservoir Upper Dam Name of town Pascoag, R.I.
 Drainage area = 8.42 sq. mi., Top of dam 449.0 NGVD
 Spillway type = Overflow - Broad crest Crest of spillway 441.0 NGVD
 Surface area at crest elevation = 500 Acres = 0.78 sq. miles
 Reservoir bottom near dam = 423.0 NGVD
 Assumed side slopes of embankments _____
 Depth of reservoir at dam site 26.0 = y_o = 26.0 ft.
 Mid-height elevation of dam = 436.0 NGVD
 Length of dam at crest = 375 feet
 Length of dam at mid-height = 323
 25% of dam length at mid-height = W_b = 80 feet

Step 1:

Elevation (NGVD)	Estimated Storage in AC-FT
441.0	5000
442.0	5500
443.0	6000
444.0	6500
445.0	7000
446.0	7500
447.0	8000
448.0	8500
449.0	9000
450.0	9500

Step 2:

$$Q_{p1} = \frac{8}{27} W_b \sqrt{g} y_o^{3/2}$$

$$= \frac{8}{27} (1.68) \sqrt{32.2} (26.0)^{3/2} = 17818 \text{ CFS}$$

NOTE: Failure of dam is assumed to be instantaneous when pool reaches top of dam, and is a partial width - full depth failure.

Pascoag Reservoir Upper Dam
Dam Failure Analysis

1. Failure discharge with pool at top of dam (elev. 449) = 17818 CFS
2. Depth of water in reservoir at time of failure = 26.0 ft.
3. Maximum depth of flow downstream of dam)
at time of failure) = 17.0 ± ft.
4. Water surface elevation just downstream)
of dam at time of failure) = 440.0 NGVD

The failure discharge of 17818 CFS will enter Pascoag Brook and flow downstream 5000 feet until the brook joins Clear River. There is significant valley storage in this 5000 feet length of brook to reduce the discharge substantially. Also due to roughness characteristics, obstructions and frictional losses, it is very likely that the unsteady dam failure flow will dissipate its wave and kinetic energy and thus convert to steady and uniform flow obeying Manning's formulae 5,000 feet downstream. The failure profile will have the following hydraulic characteristics:

DISTANCE FROM THE DAM	WATER SURFACE ELEVATION NGVD	REMARKS
0 + 00	449.0	Upstream of dam
0 + 00	440.0	Downstream of dam
10 + 00	420.0	
20 + 00	405.0	
30 + 00	390.0	
40 + 00	380.0	
50 + 00	370.0	

Beyond 5000 feet and until the brook joins Clear River, the failure discharge will flow in the below given channel characteristics:

Q = 15000 CFS; S = 0.0043
n = 0.05; b = 300 feet; d = 7.0 feet

Side slopes = 1V or 2H.

Pascoag Reservoir Upper Dam

COMPUTATIONS FOR SPILLWAY RATING CURVE

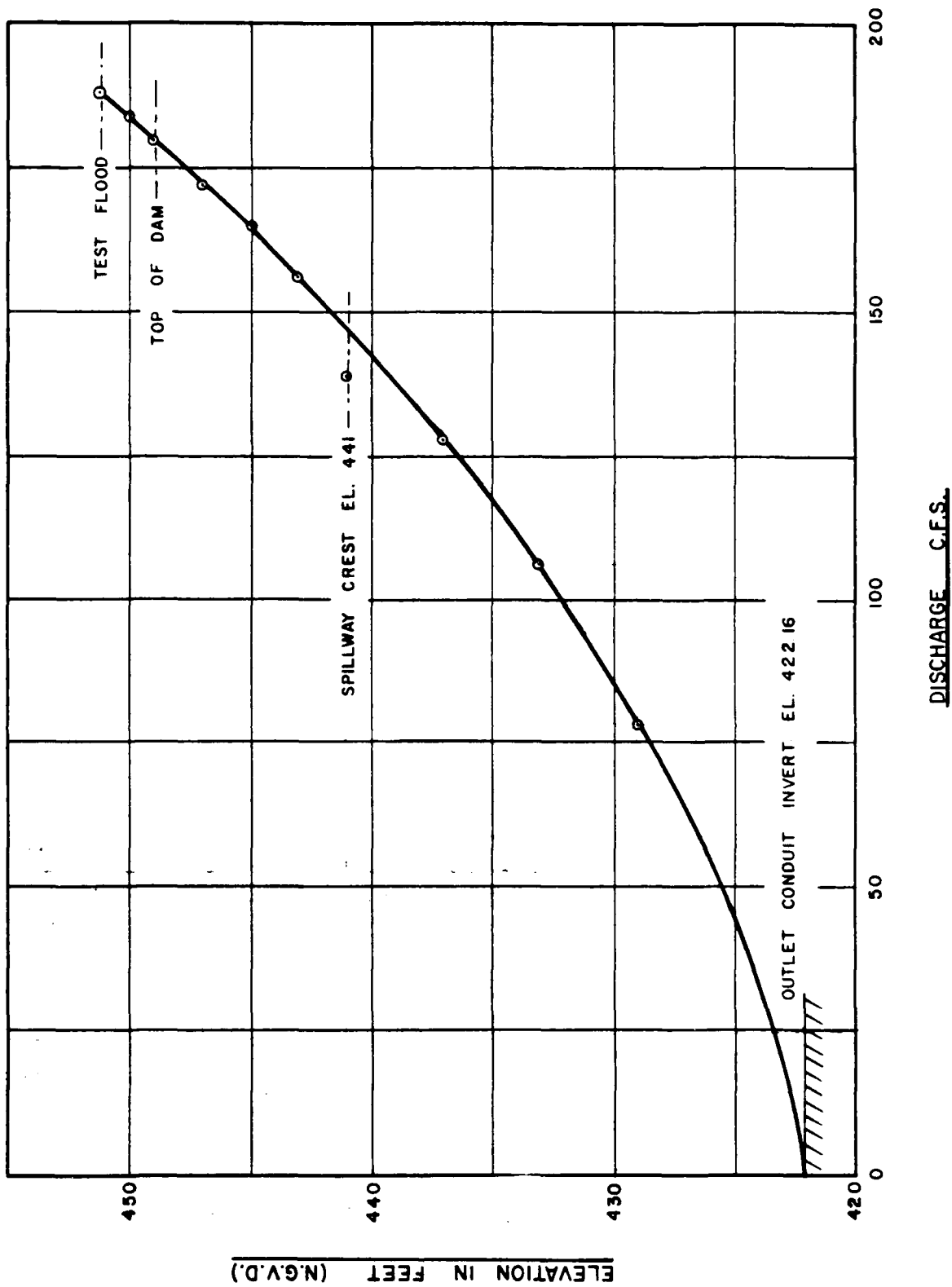
Spillway width = 21.0 feet; Spillway crest elevation = 441.0 NGVD
 Length of dam = 750 feet; Top of dam elevation = 449.0 NGVD
 C = 3.0 for spillway and dam or dike

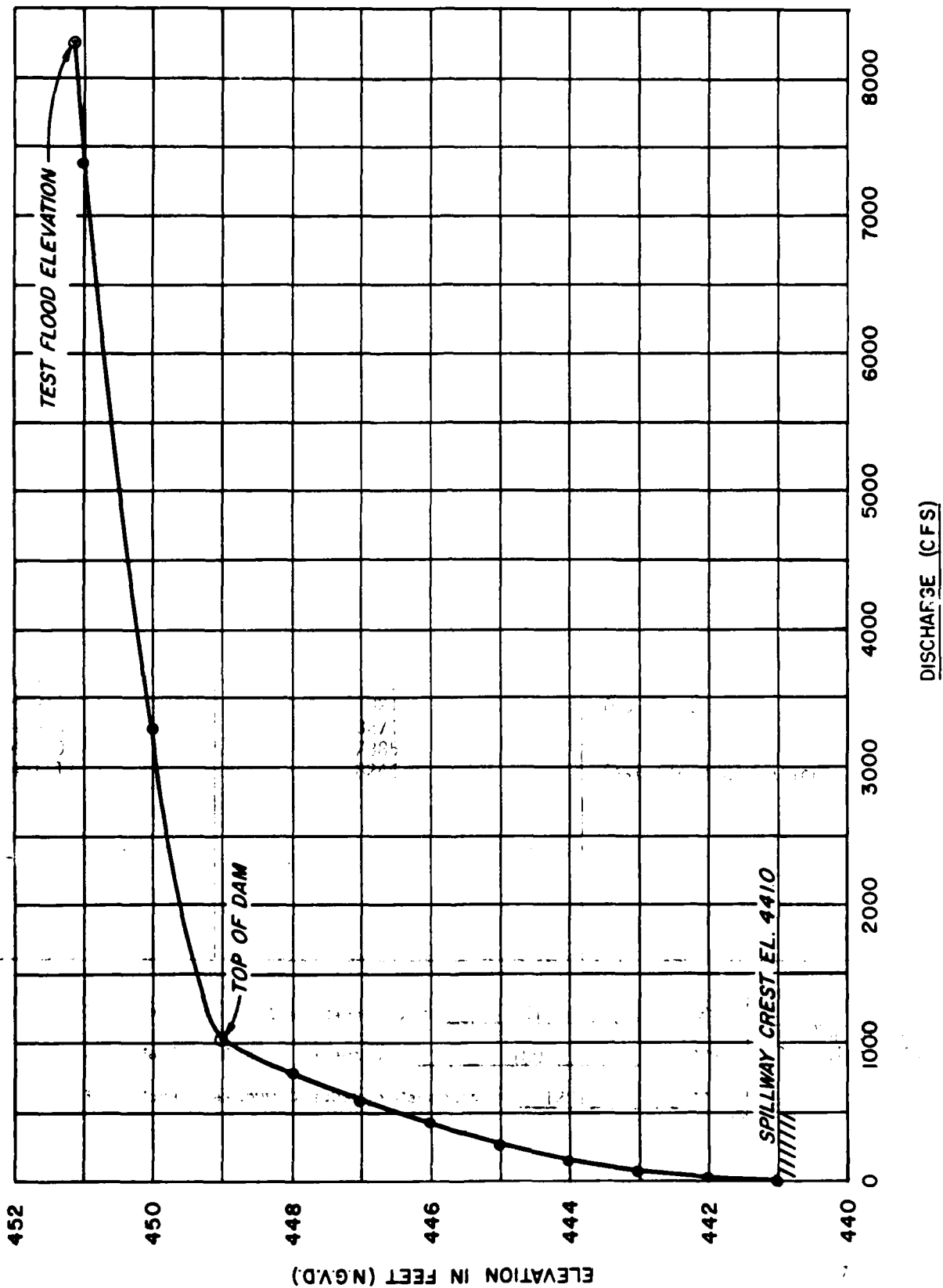
i) SPILLWAY RATING CURVE COMPUTATIONS

Elevation (ft.) NGVD	Spillway Discharge (CFS)	Remarks
441.0	0	Spillway crest elevation
442.0	28	
443.0	74	
444.0	145	
445.0	264	
446.0	416	
447.0	595	
448.0	798	
449.0	1021	Top of Dam
450.0	3271	
451.0	7385	
451.17	8246	Test flood elevation

NOTES: 1. Maximum Spillway Capacity = 1021 CFS
 2. Maximum Outlet Capacity = 180 CFS
 3. Total Maximum Discharge Capacity = 1201 CFS

For Top of Dam elevation - 449.0





APPENDIX E

INFORMATION AS CONTAINED IN THE
NATIONAL INVENTORY OF DAMS

RECORD OF DAMS IN THE UNITED STATES

(1) NAME		(2) LATITUDE (NORTH)	(3) LONGITUDE (WEST)	(4) REPORT DATE DAY MO YR
PASCOAG RESERVOIR UPPER DAM		4157.0	7142.3	00 APR 79

(5) POPULAR NAME	(6) NAME OF IMPONDMENT
	PASCOAG RESERVOIR

(7) RIVER OR STREAM	(8) NEAREST DOWNSTREAM CITY - TOWN - VILLAGE	(9) DIST FROM DAM (MI.)	(10) POPULATION
	PASCOAG	0	

(11) TYPE OF DAM	(12) YEAR COMPLETED	(13) PURPOSES	(14) STAGE HEIGHT (FT.)	(15) HYDRAULIC HEIGHT (FT.)	(16) IMPONDING CAPACITIES (ACRE-FT.)	(17) DIST OWN	(18) FED H	(19) PRV/FED	(20) SCS A	(21) VER/DATE
REGULG	1960	R	27	27	9000	5000	N	N	N	22 FEB 79

REMARKS	

(22) D/S HAS	(23) SPILLWAY TYPE	(24) LENGTH (FT.)	(25) WIDTH (FT.)	(26) MAXIMUM DISCHARGE (CFS)	(27) VOLUME OF DAM (CY)	(28) POWER CAPACITY (KW)	(29) INSTALLED PROPOSED	(30) NAVIGATION LOCKS
1	475 U	21	1020					

(31) OWNER	(32) ENGINEERING BY	(33) CONSTRUCTION BY
PASCOAG RESERVOIR CDP	UNKNOWN	UNKNOWN

(34) REGULATORY AGENCY	
(35) DESIGN	(36) CONSTRUCTION
NONE	NONE

(37) INSPECTION BY	(38) INSPECTION DATE DAY MO YR	(39) AUTHORITY FOR INSPECTION
C. F. MAGUIRE INC	01 DEC 78	PL 92-367

REMARKS	